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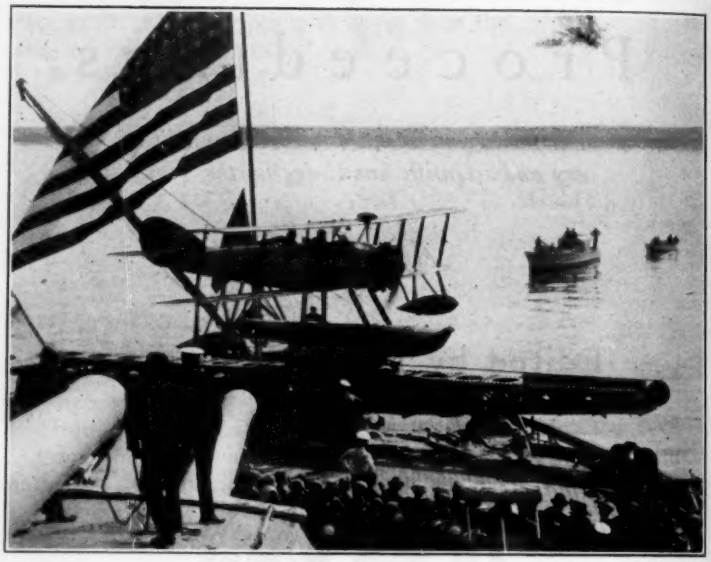

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THE CRUISER

BY LIEUTENANT (j.g.) WILLIAM WEBSTER, (C.C.), U. S. NAVY

MOTTO: "THINK IN OCEANS—SHOOT AT SIGHT!"
—LORD JOHN FISHER

EDITOR'S NOTE: Submitted in the Prize Essay Contest, 1926. Although not among the prize or honorable mention, the article was considered so important by the Board of Control that it was ordered published in the PROCEEDINGS.

DURING the past few months the so-called "capital ship" has been almost constantly under fire, and the recent launching of the new British battleships has called forth considerable comment in the press that these perhaps are to be the last of their type. The Washington Conference limited the size of ships of war to 35,000 "treaty" tons, and now it is possible that demands of expediency will still further lower this figure. Indeed, France is said to consider investing her allotted tonnage in ships of half this maximum size. All of this results in a new importance of the cruiser—that intermediate type whose name is loosely applied to ships as far extreme as the *Denver* and the *Hood*. This importance is still greater in view of the fact that, whereas the recent conference limited certain characteristics of cruisers, it placed no restrictions upon the number that might be built. This in itself has lent a significance to the type that will be exaggerated out of all proportion should we ever come to any competition in building such as was witnessed during the last twenty years.

There is no place in this paper to hold trial on the dreadnaught and the battle cruiser: however its forms may vary, it is assumed that the capital ship (in the broadest use of the word), will remain the basis of sea power. The teachings of naval history seem at least to be definite on this point. It is desired, however, to outline the development and present some ideas on the type of ship that we term "the cruiser." It has always been important—the present trend of naval events has served, for a time at least, greatly to emphasize this importance.

What is a cruiser? The dictionary's statement, "An armed vessel which cruises," is about as explicit as is the popular impression. The *Encyclopedia Brittanica* further modifies this with the phrase—"either to protect or to destroy commerce." Nothing is definite as to size, type, or characteristics, and indeed, when we consider the diverse designs that have been called cruisers it is all but impossible to fix on an absolute definition. To most persons the term is linked with the idea of speed—all cruisers worthy of the name are fast vessels.

From the days when ships differed one from another in size alone, there have been found different uses for those of different classes. And this employment has resulted in the division of vessels of war into three groups; (a) capital ships or ships of the line—the battle rates, (b) cruisers, and (c) the flotilla. All ships—barring, of course, freaks and special types—have seemed to fall within one or the other of these classifications. The boundaries between the three have at times been very clearly marked—at others they have been scarcely distinguishable.

On the whole the distinction seems to be one of employment. For many years the destruction and protection of commerce has been an important part of sea warfare. In addition to this it has been necessary more recently to provide a means of making contact with the enemy before meeting his main force—to furnish "eyes" to the fleet. These and other auxiliary duties cannot well or efficiently be performed by capital ships or by the smaller craft of the flotilla. And the cruisers of the day, past or present, have been those vessels or types to which was delegated the responsibility for the performance of these duties.

In the fifteenth century the galleasses and heavy galleys were reserved for battle, and the lighter galleys did the scouting work, carried dispatches, and generally harassed enemy shipping. How-

ever, these lighter craft—the cruisers of their day—almost invariably took their place in the line of battle along with the larger and heavier ships. During the period of Henry VIII, who is considered by many to have been the father of British sea force, the cruiser type disappeared and there was no intermediate stage between the battleship of that day and the flotilla. This state of affairs continued for more than a century and it was not until about the time of the War of the Spanish Succession that the type reappeared.

It may be considered that Anson was responsible for the introduction of the true cruiser—a ship that was no longer a small battleship but a design distinct both from the flotilla and the heavier rates. This was the frigate of 28 to 32 guns, fast and handy, and specialized for its logical function. It was too light to take its place in the line of battle but was able, of course, to avoid action with the more powerful ships. This class of ship persisted with but little change from its advent around the middle of the eighteenth century until the middle of the nineteenth. The American frigates that did such splendid work against both French and English vessels were a special cruiser type—very heavily gunned. During the year of Trafalgar the British Navy list carried the names of 556 sea-going warships, of which only 106 were ships of the line. The rest were cruisers, large and small, and these figures indicate the relative proportion of capital ships to cruisers at that date. We know that Nelson fully appreciated the value of the smaller ships as his continual demand for more frigates well testifies.

With the coming of steam and the following introduction of armor there resulted, of course, considerable of an upheaval in warship design, although the change was felt less suddenly by the cruiser than by capital ships. Even after masts and sails had disappeared from the latter, they were retained for about fifteen years on cruisers. This was due to the necessity that vessels of this type keep the seas for long periods of time, and the fact that it was some few years before a steam driven ship was able to sustain the speed that a fast sailing vessel was capable of making under good wind conditions.

This backwardness of cruisers in design is in striking contrast to their story for the next fifty years. From the early days of the "White Squadron" the rôle of the cruiser has been that

of a pathfinder in naval construction and this type has paved the way for many features that have subsequently been adopted for capital ships. This is particularly true of engineering improvements. First the water tube boiler, then the turbine and the small tube boiler—all have had their tryout on the cruiser before coming into general use. There are two good reasons that this should be so. First and most logical—the cruiser is far cheaper than the capital ship and of less relative importance. On this account, it is only natural that any innovation should be given a trial here before any chances were taken with a battleship, for few things are more conservative than ship design. The second reason is on the whole more compelling. The cruiser suffers from more limitations than does the large ship, and in order to attain her speed on a limited displacement it is frequently necessary that a bold step be taken.

The prototype of the modern cruiser was probably the American *Wampanoag* class. These ships were designed in 1864 and were termed *unprotected cruisers*. They were large, fast, heavily gunned steam-frigates and, while they were unsuccessful, they inspired the British *Inconstant*—a relatively fair design. This was followed by a number of various classes—each a modification of the preceding one. They were all intended for commerce destruction and dispatch work, and were wholly unfitted to take part in an action. The fact that they had no armor made it necessary that the coal be used for protection and that the vitals be kept below the water line.

These ships were so ill-fitted for serious fighting that an effort was made to give protection to the vitals—as well as the buoyance and stability—by fitting a vaulted armored or protected deck. Shields were also fitted to the guns and again the utmost advantage was taken of the protection afforded by the coal supply. Ships so constructed were known as *protected* cruisers—in contrast to those that had no protective deck. The earlier ships had rams and most of them retained sail power—although by this time it was auxiliary to the engines. The Japanese *Naniwa,* the Chilian *Esmeralda,* and the ships of the "White Squadron" all belong to this period. The various classes of ships were each an improvement on the one before and showed a great tendency to increase the displacement of each new type. The purpose of all of them was the destruction of commerce or its protection.

After about 1890 the design took two distinct paths. The protected cruiser had become larger than was necessary for this *guerre de course,* especially in restricted waters, and a number of smaller ships were built, following the same general lines. These ships were called *second* and *third-class* cruisers. The latter were little better than gunboats or dispatch vessels—the former were fast ships with a displacement of 3,000-6,000 tons, well gunned, and with fair protection. Our *Olympia* was one of the best of the type.

At the same time the first class cruisers continued to increase in displacement with a corresponding improvement in their speed, guns, and protection. These ships finally merged into the type known as *armored cruisers.* This was a class between the first class cruiser and the battleship. It was as large as the latter and more closely akin to it in design. To compensate for its advantage in speed, some protection was sacrificed and considerable gun power. These ships, however, represented the first cruisers that were considered capable of taking their place in the line of battle. Our "big ten" represented the finest armored cruiser construction when the dreadnaught era commenced, and therefore profoundly affected warship design.

The original conception of the dreadnaught era was that there should be nothing between powerful armored ships and torpedo craft. The last second-class cruiser was laid down in 1901 and for a few years there was practically no construction of smaller cruisers. Along with the all big gun ship came the *battle cruiser*—sponsored and staunchly championed by Lord Fisher. This was essentially a capital ship, gunned almost as heavily as the dreadnaught, but with much of the protection (from armor at least) sacrificed in order to attain high speed. This type marked the finish of the armored cruiser—as the duel at the Falkland Islands and the experience of the *Blücher* so strikingly demonstrated.

In the meantime the need for smaller cruisers resulted in the introduction of the *scout cruiser*—the reincarnation of the "catchers" of 1891-95. These scouts were the first smaller cruisers to be designed with a special battle rôle, and were intended for something more than mere war on commerce. The Russian *Novik* was merely an enlarged destroyer and was followed in 1905 by the British *Pathfinder* class. These ships had most of the characteristics of the present light cruiser, and the development from

that time to this has been gradual. Light side-armor was introduced in 1911-12, and until the very recent past the tendency has been for each new class to show a slight increase in displacement.

In addition to these regular types there have been a number of *special cruisers*—so named as a rule solely on account of the fact that they were light, fast ships. The dynamite cruiser *Vesuvius* is an example. It has also been the custom of nations, in time of war, to fit out fast ocean liners, styled *"auxiliary" cruisers,* with a few guns and send them forth to prey on enemy commerce. These are mentioned in this connection purely for the sake of completeness.

Such is the story of the cruiser—such is the background that has resulted in the ship of today. Many of these types were failures—many more were unsuited to any but a very specific purpose; and, in order to decide what duties a cruiser should properly be expected to perform, it is thought best to list the uses that have been made or considered in the past.

a) The destruction of enemy commerce—the traditional rôle of the cruiser.

b) The protection of commerce—most apt to assume the form of convoy duty, or of hunting down enemy raiders.

c) "Showing the flag." This is purely a peace-time service—best accomplished by cruisers and gunboats.

d) Dispatch and communication service, and patrol duties of various kinds.

e) Raids. These may be a bombardment of the enemy coast or fortifications, or a sortie by light cruisers or battle cruisers with the object of surprising some light naval force of the enemy. It is almost entirely a harassing maneuver, and usually has more moral than military value. Witness the bombing of the English coast during the war and the magnificent gesture of the *Vindictive* at Zeebrugge.

f) Blockade.

g) Laying mines. This is properly the duty of a special type of cruiser and no function of the ordinary variety. The fitting up of a cruiser for such service involves the sacrifice of too many other features to leave anything but a highly specialized type.

h) Carrying aircraft. Here, too, we have the need for a special type. Except where a few seaplanes are carried purely for the use of the ship itself, there is no room on a modern cruiser to

provide transport for any considerable number of airplanes. The carrier has a specific purpose and is now a distinct type.

i) Mother ships of various kinds. This, too, is special duty, and nothing to be anticipated in general cruiser design.

j) Scouting for a fleet. Here is a rôle that is considered imperative today. The cruiser is definitely marked to act as the "eyes of the fleet," and any design must recognize this function.

k) Beating off enemy destroyers. The cruiser shares with the secondary battery and the destroyers the duty of protecting the battleships from torpedo attack by the lighter craft of the enemy.

l) Support of own destroyers.

m) Torpedo attack. This should be no logical function of a cruiser.

n) Special uses in the line of battle. These apply to battle cruisers alone and are usually in the nature of rapid concentration in a fleet action or the pursuit of a retreating enemy.

A number of these uses to which cruisers have been put are, in no sense, normal duties. They are included here merely that the list may be complete and it is not considered that any thought of such a possible assignment should influence the designer.

All of these duties fall under one of two general classifications; in most of them the cruisers are forced to act alone or in company with other cruisers; in the last five they act in company with capital ships. These last uses are a thing of the past few decades and are in that sense an auxiliary function of the cruiser. Only the heavier frigates were fought in the line of battle, and the experience of numerous cruisers in the last war showed the futility of allowing a lightly armored vessel to come under the guns of capital ships.

Inasmuch as the battle cruiser has become a capital ship, it is not regarded that any discussion of its uses or merits should enter into the broader considerations of the cruiser class as intermediate between the ships of the line and the flotilla.

The use of a cruiser for torpedo attack is a most expensive proposition, and involves the risk of a valuable ship for service that any destroyer might better perform. The torpedo has no place on the present over-crowded cruiser. If we need leaders by all means build them, rather than reduce the efficiency of our larger ship designs to provide a makeshift substitute.

In the same way it is highly wasteful of material to build cruisers to support destroyers or beat off their attack. If a navy is so blessed with an over-abundance of cruisers that it can spare them from their own legitimate functions, by all means use them here. But, when we consider that four or five destroyers may be built for the cost of a modern cruiser, the futility of building the latter to do destroyer work is apparent. Better build the four destroyers and have them available for their own task, in addition to being better able than the single cruiser to engage torpedo-craft.

On the other hand, the cruiser is highly valuable for scouting purposes at a distance from the battle fleet and for making contact. It can keep the sea for much longer periods than can the lighter ships, and can operate efficiently in much rougher weather. The better radio facilities, comparative immunity from danger in a meeting with any enemy craft, and the ability to carry a couple of scouting seaplanes, give it advantages that no destroyers can hope to offset by sheer value of numbers. But this is the sole legitimate duty in direct connection with the battle fleet that the larger cruisers should be called upon to perform.

The laying of mines, and the carrying of aircraft in any quantity, must be left to vessels designed especially for the purpose—if cruisers, then only so in name. The use of cruisers for raids is also something that cannot be taken account of in design. In any expedition of this sort the most suitable vessels available at the time must be selected and the attack built up around them.

The use of the cruiser for the purpose of "showing the flag" is becoming of increasing importance. A hundred years ago when the principal nations had a great many capital ships it was comparatively easy for them to maintain a number of fleets. Now that the battleships are so reduced in numbers, it is out of the question for them to separate into more than two fleets at most. Concentration is the order of the day and there are no major ships to spare, even in peace time, for continuous duty on a distant station. This has resulted in the assignment of an increasing number of cruisers to foreign service by the various nations, and these ships are admirably suited to this duty. They can visit ports that a battleship cannot reach, they cost far less to maintain, and tie up fewer men. They can move more quickly to a trouble center, and in addition to this, they are an asset and not

a liability in the event of a sudden declaration of war. At such a time cruisers scattered over the face of the ocean are a menace to all enemy commerce, whereas battleships in similar position are a constant cause for worry until they have safely rejoined the main fleet.

For centuries the commerce of an enemy has been the subject of attack in time of war, and this work has been best performed by cruisers. The treasure ships of Spain suffered greatly at the hands of the English, and in turn during the Napoleonic Wars the cruisers of France played havoc with English merchantmen. After this came the cruise of the famous *Alabama,* and this mode of warfare received much the same impetus as did the practice of ramming as a result of the battle of Lissa. The fact that the Federal Government failed to detach proper ships to run this vessel to cover until late in the war has, in all probability, resulted in an inflated idea of the value of a raider, and certainly many of the circumstances of her career are not apt to be repeated. Baudry insists that "the day of nothing but commerce destruction is gone," and sets forth the principle that command of the sea is essential to the proper destruction of commerce. The first of these is true enough—"nothing but commerce destruction" can win no wars. But the second presupposes that one side or another will have absolute control of the sea. We must consider the case in which neither side can claim such control—here is a splendid field for the raider and here the cruiser comes into its own. But, even in the event that one side is overwhelmingly superior, the fact must not be overlooked that the cruisers of a weaker nation, if suitably scattered at the outbreak of war, may do great damage before they are all run down. A small nation, especially one with colonies, will find a number of cruisers almost invaluable. Whereas it would be able to build only one or two capital ships, it may have a couple of divisions of modern cruisers which will render far better and more economical service in war or peace.

The questions of blockade and patrol are closely allied, and these duties can be better performed by cruisers than by ships of any other type. The vessels of the flotilla cannot keep the sea sufficiently long without hardship—the capital ships should not be spared. The cruiser can run down and defeat anything but a sortie-in-force, and in this case their speed enables them to keep

clear of danger, while radioing their main body that the enemy fleet is out, and maintaining contact until supported. The duties of dispatch and communication service over long stretches are again best performed by cruisers, for the reasons just given. They need fear no enemy except that from which they are able to run away.

These last few duties are the most important of those assigned to ships of the cruiser type. The main object of naval warfare is to control the sea and to deny as much of it as possible to any ships of the enemy. The traditional "seek out and destroy the enemy fleet" is but a means to this end. And this control involves necessarily the control of communications. There is no question but that such command of the sea is secured by the battle fleet—by the superiority of capital ships, whether this superiority be due to numbers, better ships, strategy, or good fortune. It does not matter greatly whether the enemy fleet is destroyed or forced to stay under cover and its power so neutralized. What does matter is that after the ships of the line have secured such sea control there must be cruisers in order to exercise it.

The main principle of the big ships is concentration—that of the cruisers is dispersion. These latter attend to the details on the high seas. It is they that connect the bases and patrol the lanes of communication. They are capable of delivering attack at points far distant from the bases in the least space of time. They convoy merchantmen and troop ships, and blockade the ports of the enemy. They run down enemy raiders, deny the ocean to his commerce, back up their own auxiliaries and smaller vessels—mine layers, sweepers, and destroyers.

These are the duties that only the cruiser can carry out—here is their *raison d'être*. It is wasteful to use such ships unnecessarily for purposes that smaller types can do as well. But, after a superior battle fleet, concentrated at one certain point, has *secured* that intangible "control of the sea," there must be cruisers to *exercise* this control on all the oceans of the earth or the having of it is an empty thing. The cruisers are enabled to carry out their duties by reason of the security afforded them by the superiority of their battle fleet. It must be understood that no amount of cruiser strength can control the seas without capital ship superiority. But the converse is true as well, and the most powerful fleet known cannot effectively make use of any control

that it may win without adequate cruiser strength to go with it.

The performance of these duties necessitates that certain requirements be met in any design that is to be successful. In the first place it is essential that a cruiser be *seaworthy*. No matter what other characteristics must be omitted—what compromises must be made—this one feature is all important. We must have a ship capable of keeping the sea with the fleet in any weather and able to keep station or carry out its mission.

The next thing that we must design for is *speed*. Mahan holds it necessary that a cruiser have "the power to assume the offensive or to refuse battle." If a scouting cruiser observes something of importance it must be able to run away and deliver the news. If it come upon a blockade runner or intercept an enemy scout, it must be able to run the other down or all the gun power in the world will not avail. The faster that it can reach a certain point, the greater is the value of whatever other power it may possess.

A third and most important characteristic is *radius*. A cruiser should be designed to cover the greatest possible amount of territory without being forced to refuel or return to its base or rendezvous for any purpose whatever. This is particularly true in the case of the commerce destroyer—especially where its sphere of action may be at a distance from any home port or friendly base. An increase of fifty per cent in radius here is apt to lend about two hundred per cent additional value to the ranger who must spend so much of his fuel in getting back and forth to his station. If the ship belong to a nation that has not the control of the sea this feature becomes even more imperative; for here each trip to the base entails great danger of capture or destruction. It has almost universally been the case that raiders have been run down while attempting to obtain additional fuel or supplies.

In addition to the three outstanding requirements that every cruiser must meet, another most important one, and along a different line, is the question of *cost*—both for the original outlay and for upkeep. No nation has unlimited funds, and if a certain amount is provided for cruisers that nation that can get the most for its money has an initial advantage. Too seldom is this feature taken into account, for frequently great expensive cruisers have been built when three smaller ones might have been provided, and together have been of far more value to their fleet. The question of "overhead"—the men tied up and the fuel and stores

used up—the trained men lost if one cruiser is put under—all of these things are worthy of balancing against whatever is believed to be gained by an increase in size.

After these four requirements come the demands of the battery. A cruiser should be able to *hit hard*. Better to sacrifice a little protection—trust to Lord Fisher's axiom that "speed is armor," and put on as many sufficiently heavy guns as can be carried. These guns must be able to fire rapidly and there must be enough of them to fire on several attackers at once, for the ship must be invincible against destroyers.

In addition to the above major requirements a cruiser should have as much protection as is possible. This will be little enough. The guns should have shields of some sort; and the sides, enough armor to keep small shells from reaching the vitals. The buoyancy cannot well be protected. If it is possible to carry a couple of seaplanes, these will greatly extend the range of vision of the ship. A powerful radio outfit is of great value, and adds but little weight. But any other requirements are secondary to the five major considerations—*seaworthiness, speed, radius, cheapness,* and *hitting power*. The lack of any of these but cheapness will leave a poor cruiser—the lack of cheapness will probably leave too few of them.

Given these requirements, the problem is to design a ship to meet them. Here we run into two additional restrictions. The first is the limit on size and guns imposed by the Washington Conference. Our ship may not exceed 10,000 treaty tons, and must carry no guns larger than 8 inches. The second is the fact that, however perfect our theoretical considerations, we must always face the fact that ships are built to fight other ships—these latter usually built or building—and that the power and speed of these enemy designs must always be kept in mind.

Darrieus is responsible for the statement that it is foolish to enlarge on cruisers purely because they may have to face some better ship. Simply because such tactics are cumulative, and in the end we shall be forced to return to our original design (with nothing gained), or build a mastodon. And, it may be noted that cruiser construction has seemed to move in cycles—the nations building larger and larger ships and then starting over with what amounts to a big destroyer and repeating. It would appear to be better to compromise and build cruisers of two distinct types.

The first should be as small as is possible, consistent with the requirements outlined. The other should be large enough to hold its own with any cruiser afloat. This latter proposition is easier to meet in view of the Conference limitation. These larger cruisers will be able to back up the smaller cruisers—since the largest ship in a line or group lends its strength to the whole unit and is a continual threat against any enemy force. The smaller cruisers can be produced and maintained to twice the number that would be the case if all larger ships were built. They will cover much more ground, and the loss of any single ship will represent much less of a blow to the whole force. There is a tendency toward such a reduction in size at present—as may be seen from the design of the new French cruisers of the *Jaguar* class.

These minor cruisers must be cheap to construct. Their greatest advantage lies in their number, and for the same total expenditure this is in inverse ratio to the cost. It is most advantageous to build these vessels in homogenous squadrons. They not only cost less but are of much more military value. Replacements are easier and each ship may profit by the experience of the others. Slight improvements on a design are rarely satisfactory—they add to the cost and delay the completion date. Once a ship has been started, let it be finished as planned.

The "sea speed" is of much more importance than any still-water performance, and a ship must be able to make its knots and work its guns in pretty heavy weather. Here is where gun shields come in. The ratio of cruiser speed to merchant ship speed (even for a fast vessel) has increased so much in recent years that there is no longer any question of ability to overhaul a prize or blockade runner. On this account the speed of a raider is governed by that of any enemy of equal or greater fighting power. The last thing a commerce destroyer desires is to fight.

Radius is now almost entirely a question of fuel. Stores and ammunition will last for a long time, but the modern ship runs out of fuel very rapidly, even at economical speeds. The question of using Diesel engines for cruising (in a commerce destroyer) is well worth consideration on account of the greatly increased mileage that may then be obtained from a given quantity of oil.

The guns on smaller cruisers need only be sufficiently powerful to overwhelm destroyers. Five and a half or six-inch would ap-

pear ample. Their volume of fire is much greater than that of the larger guns, and a hit on a destroyer or leader is just as serious. The larger cruisers are practically forced to the eight-inch (limit) size if they are to engage ships of existing design.

It is assumed that all ships will burn oil. Those of the large type might well carry seaplanes, although the smaller ones would have no room for them. The large ships have no need of torpedoes. The smaller ones may carry them if very small—not if they displace over 4,000 tons. Both types should be rugged, and as simple as possible in design. These ships get far from base, and there should be a minimum of things apt to go wrong.

A proper cruiser should be a ship able to maintain itself for long periods of time and to look out for itself when confronted by any enemy. When backed by a sufficiently strong battle fleet, it should be capable of insuring the safety of the seas to the commerce of its country and denying the ocean to the shipping of an enemy.

The following conclusions are set forth:

1) The cruiser is a type, distinct from capital ships and the flotilla, and distinguished mainly by its speed.

2) The main function of the cruiser is to exercise that control of the sea that is secured by the battle fleet.

3) Auxiliary functions are the attack on and protection of commerce, and scouting duties with the fleet.

4) The building of cruisers offers a tempting solution to the naval problems of the smaller nations—especially those with colonies.

5) The vital requirements of any cruiser are, (a) *seaworthiness,* (b) *speed,* (c) *radius,* (d) *cheapness,* which represents *numbers,* and (e) *hitting power.*

6) These requirements would seem to be best met by building cruisers of two types:

a) Numerous ships—as small as consistent with (5).

b) A number of cruisers that are as powerful as may be built.

SUMMARY OF GERMAN SUBMARINE OPERATIONS IN THE VARIOUS THEATERS OF WAR FROM 1914 TO 1918

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Editor's Note: This paper is a translation made by Commander W. P. Beehler, U. S. Navy, Retired, who was our naval attaché at Berlin after the war. The original paper was prepared by Captain A. Gayer of the German Navy and read by him as a lecture at the Admiralty. The writer's style was academic rather than popular, and the translator has adhered as closely as possible to the spirit of the German author. Special permission was obtained from author for this translation and to publish in the Proceedings.

BEGINNING in the German Bight in the North Sea and the Baltic, the submarine warfare expanded in the various theaters in accordance with the military preparations previously made in the course of the war, and assumed ever greater proportions. As early as the end of 1914, German submarines operated off and on from the Flanders coast, until 1915, when a regular base was established there, which was continued until the end of September, 1918.

In the Baltic, Kiel and Danzig were the original bases. After the capture of Libau, in the beginning of May, 1915, this port became the main base for submarine operations in the Baltic.

In the Mediterranean, submarine operations were commenced in May, 1915. The principal bases were Pola and Cattaro. Auxiliary bases on the coast of Asia Minor began to assume importance as well in the early part of 1915.

In August, 1915, the operations expanded into the Sea of Marmora and the Black Sea.

These submarine operations in the Baltic and in the Black Sea were only of local importance and played a minor rôle in the larger mission of submarine warfare as a whole. The sinking of

the Russian cruiser *Pallada* by the submarine *U-26* was the first of our successes in the Baltic.

Although even at this stage the submarine bases embraced a very considerable area, this was even further extended by the increased radius of action of our submarines. In September, 1916, the *U-53* made the first submarine cruise to America.

About the same time, submarine operations were undertaken which extended as far as the Polar Ocean, while in November, 1916, three other boats operated regularly as far as the Canary Islands. This submarine cruiser warfare was pushed into the far West and South Atlantic with regularity by the end of 1917.

Over seven years have passed since our last torpedo reached its target, and the memories of the wide field we then controlled seem like fairy tales in the light of our present helplessness.

We shall try to show in the following condensed résumé how this weapon, insignificant at the beginning of the war, was called to great deeds; how it developed and came into conflict with politics, which resulted in its downfall and the loss of a favorable peace for Germany. Also, other points will be touched on, aside from the unholy political interference with submarine operations, which may hold lessons for the future.

Prefacing these remarks, it should be stated that when one refers to submarine operations one generally means those operations against merchant shipping. This, however, does not hold in our historical résumé, and all forms of submarine operations in war will be considered.

As our eighteen war-serviceable boats stood out to the North Sea towards the latter part of July, 1914, no one thought at first of operations against merchant shipping, but hoped to make contact with enemy forces in joint operations with the High Seas Fleet. The maneuvers in May, 1914, had shown that the possibilities for joint operations with the fleet were very favorable, and that by such means some measure of equalization could be obtained against a superior enemy force. True, before the outbreak of the war, one of our best technical experts on this weapon, Lieutenant Commander Blum, had calculated the number of submarines necessary to conduct cruiser warfare against England, and had placed this number at 200. That his calculations were about right is shown by the fact that during the war we never had more than 150 submarines in service at any time; and at that

came very close to success. Further, in time of peace, no special provision had been made for construction and fitting out of these boats for this service. As a result of the operations orders at the outbreak of the war holding the fleet in reserve, no joint operations with the fleet were possible; rather, as it developed that the enemy was not inclined to penetrate the German Bight except with submarines, our boats were more and more diverted to individual operations against enemy warships. This method of employment together with others to be mentioned was continued until February 18, 1915. The first success was the sinking of the *Pathfinder* by Lieutenant Commander Hersing with the *U-21,* near the Firth of Forth, on September 5, being the first submarine success in history. The sinking of the *Hogue, Aboukir,* and *Cressy,* near the Maas lightship on September 22, and of the *Hawke* on October 15, by the *U-9,* Weddigen; the sinking of the English submarine *E-3* near the mouth of the Ems and the aircraft tender *Hermes* near Calais on October 31 by Lieutenant Commander Wegener, *U-27;* the destruction of the gunboat *Niger* near Deal on November 12, 1914, by Lieutenant Commander Forstmann, *U-12;* and finally, the sinking of the battleship *Formidable* during New Year's night, 1915-16 near the South Coast of England, by the *U-24,* under Lieutenant Commander Schneider, are the outstanding successes of this period. Aside from these sinkings in the early period of the war should be mentioned certain eventful cruises which paved the way for other operations later on, namely, the first cruise through the Dover Strait by the *U-18,* under Lieutenant Commander von Hennig; the penetration of this boat into Scapa Flow; the first cruise circumnavigating England and Ireland by the *U-20,* under Lieutenant Commander Droescher; the penetration of the *U-16,* under Lieutenant Commander Hansen, into the harbor of Lerwick in the Shetland Islands; as well as the first operations from the Flanders bases (Zeebrugge and Ostende) by the *U-5,* Lemmer; *U-8,* Stoss; *U-11,* Suchedeletz; *U-12,* Forstmann; *U-24,* Schneider. Notable as were these achievements in themselves, many cruises were needed in preparation for them before results could be obtained. In these individual operations of the submarines, the means of luring the enemy warships into positions favorable for submarine attack were lacking, and many opportunities were missed by the fact that the low submerged and surface

speeds of the submarines prevented their attaining a suitable position for attack.

So it came about that, quite unconsciously, ways and means were sought at the front to increase the effectiveness of the submarine operations. Joint operations with the fleet were sought at first and finally obtained. Thus, in the middle of August, a raid was made to the Hoofden by the cruisers *Stralsund* and *Strassburg,* accompanied by two submarines, which, however, had no opportunity for attack, since the cruisers came only in contact with enemy destroyers and attacked at long range. When the High Seas Fleet made its first offensive on November 3, with the object of bombarding the English coast near Yarmouth, the available submarines were disposed in such a manner that they could give warning of approaching enemy forces and cover the retreat. Since the German cruisers were not annoyed by strong naval forces, the submarines did not come into action. In the coast bombardment of December 16, 1914, this branch of the service cooperated in the following manner: two scouting trips were made by the submarine *U-27,* under Lieutenant Commander Wegener, in which the mine fields were charted and safe courses for the fleet laid out for the proposed bombardment. Otherwise, the submarines did not participate in these operations, as the other boats were then engaged in individual enterprises.

It was such an undertaking which caused Lord Jellicoe to express his astonishment that the Germans had not used the submarines in joint operations to cause the enemy forces to run into a trap, such as actually occurred on our side on August 19, 1916. Had our submarines been employed in this raid (in the manner in which they were actually used on August 19) they would probably have discovered that the Second British Battle Squadron was in such a position between our main body and the battle cruisers that further operations to the westward would have probably resulted in the destruction of the enemy Second Battle Squadron. That such an event would have had far reaching influence on the course of the war is clear.

During the raid of the German battle cruisers *Seydlitz, Moltke, Derfflinger,* the armored cruiser *Blücher,* and their screen of light cruisers and destroyers near the Dogger Bank on January 24, 1915, the cooperation of submarines would have been of the greatest importance, since this raid was carried out without the support of

the Battle Fleet. As early as the afternoon of the twenty-third, four submarines were stationed at the mouth of the Ems and two near Helgoland, ready to proceed toward the objective of the battle cruisers. These could then have been used on the twenty-fourth during the battle as well as against those British ships which were being towed after the battle. The flotilla commanders at the Ems and Helgoland did send out their boats to engage the superior British battle cruisers as soon as the signal was received from Admiral Hipper that he was engaged; but it was too late, as the fight was broken off, as the British themselves reported, before they came into the area of German mines and submarines. So again, opportunity failed to bring the submarines the long sought chance of a shot at the enemy battle fleet.

Since these methods had not produced any very effective results, the idea of using the submarines as commerce raiders was considered relatively early. Even before Weddigen's great accomplishments, conferences had been held with the Commander Submarine Divisions, Commander Bauer, to consider action against England's commerce. This concept was shattered on the question of the means to be employed to attain the end in view. The English author, Sir Conan Doyle, had written a pamphlet before the war describing how a small country, with the aid of only seven submarines, could force Great Britain to sue for peace. Since the problem appeared so easy to Sir Conan Doyle, it possibly explains why such remarkable optimism existed in high places in regard to our own problem. They were possibly influenced by Doyle's exposé. (In time of peace, no particular preparations were made for the employment of submarines as commerce raiders.) The thought was expressed from the front in the form of a memorandum from the Commander Second Squadron to Berlin, and caused Grand Admiral von Tirpitz to sound out the American correspondent, von Wiegand, as to the attitude of the United States toward a commerce war instituted by Germany (November, 1914). Tirpitz sought in this manner with the best motives to clear up the political complications of a submarine offensive against commerce. Naturally, the interview meant the disclosure of military operations, and had the disadvantage that notice was given to Great Britain to prepare for a counter-offensive. The idea of a commerce raid with submarines spread more and more until on October 20, 1914, Lieutenant Commander Feldkirchner

in the *U-17* sank the small British ship *Glytra* near the Norwegian coast, in accordance with the recognized principles of international law. Further sinkings followed this until the declaration of the submarine blockade on February 18, 1915, when about 20,000 tons had been sunk. These were individual operations which could not in the nature of things have any important results, but which did stimulate the English to greater offensive measures.

The declaration of the submarine war area on February 18 (known as the submarine blockade) introduced the second phase of submarine warfare It has been very much disputed as to whether or not this undertaking was not rather previous. Tirpitz himself was not in agreement with the early date set. Also, at the front, opinion was divided as to whether the submarine service was sufficiently strong for the undertaking. The blockade offensive could only be carried out in the North Sea with a number of trained boats which never exceeded twenty-five before it came to a sudden end in October, 1915. As late as February, 1915, eight of these boats were fitted with gas engines which were notoriously unserviceable for war, and very few of the boats were even equipped with guns. In itself, the declaration was somewhat sharp and did not depart fundamentally from the principles of an intensive submarine offensive. But even before the actual operations were commenced by the boats, the severity of the methods, as stated in the declaration, were considerably modified. As early as late February, orders were issued concerning the careful treatment of neutrals, and particularly the Italian and American flags. For the Scandinavian countries a "free safe lane" was ordered for trade with England until the end of March. Further restrictions resulted from individual sinkings which will be treated later.

During the period of this submarine blockade (until the end of October, 1915), eleven of our boats were lost to the enemy. The boats had to be trained to this new manner of employment, and the dangers which threatened had to be learned by experience. Among these were: traps through the misuse of neutral flags, concealed guns on apparently innocent looking craft, joint operations of enemy submarines with enemy merchant ships. Possible counter-measures were: to avoid submerging or emerging at short distances from a steamer capable of carrying good armament, avoidance of stopping after sinking to render attack from accompanying submarines more difficult, and the prompt evacuation of

the area after a successful attack. It proved advantageous to carry merchant marine officers as war pilots on the submarines, as these officers possessed particular knowledge of enemy and neutral shipping. After these pilots had become accustomed to the methods of operation with the submarine commanders of experience, they became invaluable as advisers to new submarine commanders ordered to operate in the blockade zone. Further, it paid to take aboard competent radio operators, who, by deciphering enemy radio traffic, were enabled to render valuable service. In this manner, boats were frequently enabled to intercept news of measures to be taken against themselves. A good means of safeguarding the boats in these operations against the enemy was a careful training cruise by which all faults of material could be established beforehand. Careful avoidance of the tell-tale oil and gasoline tracks was a matter for the most careful consideration of the responsible division commanders.

The principal operation areas for the war on enemy commerce were in the neighborhood of the English Channel and the Irish Sea, the west coast of France and the approaches to these areas from the Atlantic Ocean. The shortest route to these areas lay through the Straits of Dover. At that time, even the larger North Sea submarines were able to pass through there unhindered. This route was first closed by nets early in April, whereupon the larger boats chose the route around the northern part of England. In May, 1915, the Mediterranean and, shortly after, the Black Sea, were added to these areas. March 29 was the real birthday of the base in Flanders, which was composed of boats sent partly by rail to Zeebrugge and partly by sea, consisting of the smaller *B* and *C* class boats. The *B* class boats carried torpedoes, while the *C* boats carried mines.

The number of boats operating from this base increased gradually to sixteen by October, 1915, while only two were lost during this time. At first, these small boats operated principally in the Hoofden, where they raided the commerce between Holland and England, while the mine layers laid minefield after minefield at the mouth of the Thames. These operations found the enemy particularly unprepared. The Dover Straits were passed first by the *B* boats early in July, while the *C* boats followed in August, laying mines with great success near Boulogne. As pioneers in Flanders, Lieutenants Steinbrink and Pustkucken rendered val-

uable service. It was rather astonishing what these officers were able to accomplish with their small boats propelled by only 60 h.p. engines. The Flanders coast thus became the high school of submarine art as early as 1915.

During this period the war was also carried into the Mediterranean. At first the operations in this area were not in the nature of commerce raids, but were intended primarily to relieve the hard pressed Dardanelles in their stand against the Allied men-of-war. The *U-21,* under the command of Hersing, was selected for this duty. On April 21, this boat put out to sea, taking the northern route by the Orkney Islands. On the Spanish coast he found opportunity for refueling, only to discover later, to his sorrow, that the fuel was worthless. Thus a difficult decision had to be made, whether to return to his base or attempt to carry out his mission. He held to his mission, and on May 13 reached Cattaro with forty-two tons of fuel on board. The Straits of Gibraltar were passed on the surface at early dawn, just as the British destroyers on patrol were steaming northward to be relieved. Seven days after arrival in Cattaro, Hersing sailed for the Dardanelles, passing through the Cerigo Straits and the islands of the Aegean. On May 25 he then torpedoed the English ship *Triumph,* near Ari Burnu, and on May 2 the British battleship *Majestic,* at Sedd el Bahr. On June 5 he steamed into the Dardanelles and was greeted in Constantinople with great acclaim as a deliverer. Aside from the *U-21,* the war in the Mediterranean was opened by a number of small boats which were transported by rail to Pola and assembled there under the supervision of a special commission. These consisted of six small torpedo boats and four small mine layers of the same construction as those on the Flanders coast. Three small torpedo submarines had preceded Hersing in the Dardanelles, but had achieved no marked success. As opposed to Hersing's operations, the five large submarines which proceeded to the Mediterranean late in the fall of 1915 immediately embarked on commerce raids. In the limited space of this article, the operations of the submarines in the Mediterranean will be briefly sketched out to the conclusion of the war. This is justified by the fact that from 1915 to the end of the war the commerce raids in this area were continued without variation, in contradistinction to the operations in the other war areas. In the summer of 1915 sinkings of 50,000 tons

were not rare in the Mediterranean. Among other things, the best boats were sent there under the command of the most experienced officers (Forstmann, Kophamel, Valentiner) and operating conditions showed themselves to be unusually favorable; steamer routes were easy to find, weather and visibility conditions were considerably better than in the North Sea, and counter-offensive measures were almost entirely lacking. In the Mediterranean, the Allies did not possess a number of small boats suitable for submarine chasing, and could not organize in that area such a patrol as existed in the English Channel and the Dover Straits. It was unfortunate for us that we did not send more large submarines into the Mediterranean in the fall of 1915 when the submarine cruiser warfare was suspended. (This will be discussed later.)

Not until 1916, when the submarine activities in the North Sea had been suspended for a second time, were four more large submarines and one mine layer sent to the Mediterranean, to be followed shortly by six improved small torpedo submarines. One unfortunate fact was that a large submarine, the *U-33*, was kept for one year, and the *U-38* from May until August, 1916, operating in the Black Sea, where they were able to sink only four steamers, four sailing ships, and two fishing boats, aside from the bombardment of enemy coast stations. In the Mediterranean, they would have been able to accomplish at least ten times that much. For the problems of the Black Sea, the small boats would have been ample.

One circumstance was particularly unfortunate. When we entered the Mediterranean we found at Pola an Austrian dockyard, and at Cattaro, a repair ship. We contented ourselves with these few repair facilities, simply supporting them with German personnel and material. No extensive construction work, such as was carried out at Zeebrugge under Captain Bartenbach, was undertaken here. Thus, it came about that from the end of 1916 to the beginning of 1918, when operations in the Mediterranean were at their height, the repair periods for the submarines became of longer and longer duration. By 1918 these delays took on alarming proportions. The chief of the Submarine Bureau in 1918 then took the situation in hand and ordered the construction of docks and shops on a large scale in both Pola and Cattaro. Further, the repair facilities at both Trieste and Fiume were

considerably expanded. Owing to the Austrian collapse, the latter measures were not fully carried out. For us, the tragedy lay in the fact that we never consolidated the occupation of Avlona, which would have made the passage of the Straits of Otranto very much easier. The commerce raids in the Mediterranean brought a toll of nearly 5,000,000 tons of enemy shipping. This number was in accordance with previous calculations. Some individual commanders obtained astonishing results. Lieutenant Commander Arnauld de la Perière sank nearly 42,000 tons with the *U-35* up to March 13, 1918, when he returned home to take command of a submarine cruiser, while the former boat was laid up for a long repair period. As successful commanders of the smaller boats, the following are outstanding: Lieutenants Steinbauer, v. Mellenthin, and v. Marschall. Submarine operations in the Mediterranean were directed from 1915 to June, 1917, by Commander Kophamel, and from that time to the end of the war by Captain (later Commodore) Pullen, a very fortunate circumstance. As time went on operative possibilities became clearer and the situation easier to control, so that by April, 1916, it was possible to carry on commerce raids under the rules of war for prizes. During the whole war, only seventeen boats were lost in the Mediterranean, due to enemy counter offensive measures. Only the month of May, 1918, was serious, when five boats were lost. In the early part of 1918 the English took the patrol of the Mediterranean seriously in hand, and took over the patrol of the Otranto Straits from the Italians, thus making it effective for the first time. Aside from the cruiser warfare, the submarines in the Mediterranean played a large rôle in coast bombardments and in transport service. As to the latter, some went to Constantinople (during the time when the route through Roumania was not fully open to us) and some from Pola and Cattaro to North Africa, where the natives under Turkish leadership were supplied with war material for their operations against the Italians. In the main, the small minelaying submarines were used for this transport service. At times, the larger submarines were also used for this service, which unfortunately diverted them from their real mission—cruiser warfare. Aside from Hersing's success against the *Majestic*, the following men-of-war were sunk:

On June 10, 1915, the Italian submarine *Medusa*.

On July 7, 1915, the Italian armored cruiser *Amalfi*, both sunk by one of the small submarines.

On November 5, 1915, the English submarine *E-20*, by the *UB-14*, under Lieutenant v. Heimburg in the Sea of Marmora.

On February 8, 1916, the French armored cruiser *Admiral Charner*, by the *U-21*, under Hersing near the Syrian coast.

On February 19, 1916, the French small cruiser *Primula*, by the *U-35*, under Lieutenant Commander Arnauld de la Perière near Malta.

On April 28, 1916, the English battleship *Russell*, the sloop *Nasturtium*, and the armed yacht *Regusa*, on mines near Valetta (Malta), which were laid the day before by the *U-73*, under Lieutenant Commander Siehs.

On December 27, 1916, the French battleship *Gaulois*, by the *UB-47*, under Lieutenant Commander Steinbauer, in spite of convoy of fishing vessels and light cruisers.

On January 9, 1917, the English battleship *Cornwallis*, by the *UG-32*, under Lieutenant Commander Hartwig, near Malta.

On March 19, 1917, the French battleship *Danton*, by the *U-64*, under Lieutenant Commander Morath.

On December 14, 1917, the French armored cruiser *Chateaurenault*, by the *UC-38*, under Lieutenant Commander Wendland, in which engagement the latter was lost.

Aside from this, about forty small warcraft and chasers were sunk. On his way to the Mediterranean past the Canary Islands, Lieutenant Commander Walther Hans sank the French battleship *Suffren*, near the Spanish coast on November 26, 1916.

When the collapse of Austria forced the German submarines to retreat from the Mediterranean to German ports, the *UB-50*, under Lieutenant Kutat, sank the British battleship *Brittania* near Cape Trafalgar on November 9, 1918. This was the last action at sea by the weapon which had so brilliantly survived the collapse of our allies. About a dozen other small warcraft which were sunk during the war in the Mediterranean cannot be recited owing to lack of space. In February, the submarines took a large part in fighting against the sailors' revolution in Cattaro (*U-35*). Some of the large and some of the small submarines had to be destroyed in the evacuation of Pola and Cattaro, as they could not be made seaworthy for the trip home.

We will now turn back to the theaters of war near home, which we left temporarily with the entrance of the *U-21* into the Mediterranean in April, 1915. The time of the submarine blockade brought with it many successes, and at the same time great losses. Weddigen was not to carry out any more raids in this warfare. Early in March he had proceeded from the mouth of the Ems through the Dover Straits with the *U-29*. Ostend was sought out for a short time, and then English newspapers spoke of

important successes of Weddigen. After this, an ominous silence. The rumor gained currency that he had fallen into a trap through misuse of neutral flags. Finally, after the war, Admiral Jellicoe lifted the veil in his book *The Grand Fleet from 1914 to 1916.* From this it seems that v. Weddigen did not go through the English Channel, but proceeded northward, arriving between Peterhead and Norway on March 18, encountering the British Fleet. Owing to lack of torpedoes he was forced to fire from his stern tubes, as a result of which his periscope was sighted and he was rammed and sunk by the *Dreadnought.* Whether or not a certain difficulty in diving, which was a defect of the boats from *U-27* to *U-30,* was responsible for this loss we cannot judge. With Weddigen, we lost one of the pioneers of the submarine service whose efficiency and thorough understanding of the boats would have been of inestimable value to our service.

After 90,000 tons had been sunk in March, 1915, and 40,000 in April, came the episode which was to be the beginning of a series of political complications which lasted from that time to the declaration of war by the United States, in the spring of 1917.

This was the sinking of the *Lusitania* on May 7, Lieutenant Commander Schwieger, off the Irish coast near Kinsale. The commanding officer of the submarine was led to believe from official lists that the *Lusitania* was an auxiliary of the British Navy, and that she was engaged in carrying munitions from the United States to England. He was strengthened in this conviction by the fact that the German ambassador in Washington had cautioned the American citizens against traveling on this ship, as she was carrying contraband. As the result of this sinking, there began an exchange of notes in which our political leaders gave ground on each successive occasion, until finally a point was reached where submarines were forbidden to sink any passenger ship, even enemy ships. Otherwise, the cruiser warfare was continued. Among particular outstanding cruises at this time are to be mentioned the trip of the *U-35* under Lieutenant Commander Kophamel to the west coast of Great Britain, which resulted in the sinking of fourteen craft of 24,000 tons total displacement; the cruise of the *U-39* under Lieutenant Commander Forstmann between Scilly and Ushant in July, netting fourteen craft totaling 36,000 tons; the record cruise of the *U-35* under Lieutenant Commander Valentiner, which in August accounted for

twenty-two freighters, five fishing vessels, and three sailing vessels in St. George's Channel and the Bristol Channel, in all about 70,000 tons. In August, the *Baralong* incident is to be noted, which came as a result of the precautions which were ordered to be taken with American ships. The commanding officer of the *U-77*, Lieutenant Commander Wegener, who had distinguished himself in the beginning of the war, met his death here. The sinking of the *Arabic* by Lieutenant Commander Schneider on August 19, 1915, brought about a continuation of the political complications started by the sinking of the *Lusitania*. After Schneider had destroyed a benzine factory near Harrington on the Irish Sea, he was attacked by a large English steamer on August 18, without, however, receiving any damage. On August 19 he sank the *Arabic*, expecting from his experience of the day before that the ship was employing offensive tactics, since she appeared to be ramming him just as he was about to torpedo another vessel. Only when he returned to port did he discover that this was the White Star Line ship *Arabic* which had just sailed from Liverpool for New York with 170 passengers and a crew of 250 men. Further, there was about 8,000,000 marks worth of English gold aboard, and three American citizens who were drowned.

The German Ambassador in Washington stated, without official authorization, that the "submarine commander had exceeded his instructions and would be punished for the act." The *Arabic* case let loose a storm of dissension in general headquarters. Von Tirpitz and the chief of the Naval Staff, Admiral Bachmann, took the stand that the submarine warfare should not be abandoned on account of the American attitude, while the Chancellor and the chief of Admiralty, Admiral v. Muller, took the stand that in spite of all the notes the still unsettled *Lusitania* case should be settled in a court of arbitration, and that in the meantime the submarine commanders should be ordered not to sink any passenger ships without due warning and without saving the crew. Although the Kaiser had decided in the sense of Tirpitz and Bachmann on August 26, the Chancellor on August 28 promulgated a new decision in accordance with his own views. This fateful despatch was transmitted to America. Bachmann was forced to resign and was replaced by Admiral von Holtzendorff, who had been previously retired. The relations between Admiral v. Tirpitz and the Supreme Command were badly strained. It was distinctly felt at

the front that the submarine warfare, even in this restricted form, was doomed to early extinction in the North Sea area; an idea that was strengthened by the detachment of the *U-39* to the Mediterranean on September 16. One important order to the submarine commanders was delayed in transmission to the front. On August 30 orders reached the front prohibiting the torpedoing even of small passenger ships without due warning and rescue of the crew. This order could not be absolutely carried out. How could a submarine commander distinguish between a small passenger vessel and a freighter through the periscope? In the interests of the submarine commanders the commander-in-chief, Admiral v. Pohl, who had been placed in this position as a result of the episode of January 24, 1915, protested this order. The Kaiser overruled the protest. On September 20 the commanders of the submarine forces in the North Sea and in Flanders received an order from the Supreme Command to discontinue commerce raids of any kind on the coast of Great Britain and in the Channel. In General Headquarters, the fight had been won by the proponents of an understanding with America led by the Chancellor and the chief of the Admiralty.

This order suspending operations against merchant shipping was especially painful to the personnel in Flanders, as the number of boats there had been increased to seventeen, and the long winter nights which were coming on made for greater and greater security and favorable operating conditions. They consoled themselves with the thought that the mine layers could continue their operations, however, since this could not be considered commerce raiding. Mines went to par. This forced inactivity of the North Sea boats led them to construct mines for the larger boats which could be shot out of the torpedo tubes.

The suspension of activity for the North Sea flotilla did not work quite so much hardship, since the loss of eleven boats and the detachment of six others to the Mediterranean left only thirteen, of which only four were available for operations on the west coast of Great Britain without undergoing extensive repairs. At the front, it was generally believed that all available boats in good condition should have been sent to the Mediterranean where good opportunities for success offered. Such a disposition of the boats would, however, have left the German Bight without the protection of submarines.

It is of historical interest to note that the number of neutral craft which were boarded, searched, and freed, since contraband of war could not be proven, was about 300; this during the period of February to October in the blockaded area. This represented about 700,000 tons, or more than had been sunk since the declaration of the submarine blockade.

The numerous restrictive orders, modifying the original concept of submarine cruiser warfare, had assumed such large proportions that they could not be covered in the space allowed this article. As a matter of fact, so many were issued that it was impossible for a submarine commander to learn them all, and many a time it was necessary for the helmsman or some other trusty support to bring the orders to the conning tower and hastily run through the mass to find out whether or not a certain vessel could be torpedoed. Even then it frequently turned out that "whatever you do is wrong." For a commanding officer to be continually harassed by the thought that he will be held accountable for this or that sinking, when returning from a long and arduous cruise, makes his task especially difficult. Thus, the second period shows that no matter how brilliant the military operations, nor how bravely carried through, the lack of a definite, clearcut, political objective brings the whole to nought.

The following period, from October, 1915, to the end of April, 1916, shows definite operations only in the Mediterranean. In the North Sea and in Flanders the picture is blurred. The commanders of the North Sea flotillas held to the letter of the orders, and military operations of the boats were conducted in such a manner that sinkings played only a minor rôle. In addition to this, bad weather considerably hindered the operations, as much time was lost due to the necessity for extensive overhaul periods and the work of modernizing the boats. A commerce raid of the *U-24* to the west coast in December, 1915, broke in on this period of restricted activity. These operations were ordered by the Admiralty for fear that England would shift her counter-offensive to the Mediterranean in the event that no further activity whatever was evinced by the North Sea flotillas, since only a few of the Flanders flotillas were forcing them to maintain the channel patrol. This cruise was at the same time in the nature of an experimental winter trip, on which Commander Schneider sank about 15,000 tons although he was expressly enjoined against sinking passenger

or neutral vessels. Mine laying expeditions of the larger submarines near the English coast, mine scouting cruises with the fleet under Admiral v. Pohl, and numerous transport cruises played a large rôle during that winter. Thus, the *U-20* assisted in the mine laying expedition of the auxiliary cruiser *Moewe* on the north coast of Scotland and the Orkney Islands by scouting for mine fields in these areas, during the mouth of November; while in January, the *U-70* escorted the steamer *Marie* on her trip from the German Bight to East Africa.

In Flanders, until February, 1916, there was great activity among the mine laying submarines. The small *B* boats were engaged on patrol duty on the Flanders coast. From November 21, 1915, on, ships under the enemy flags which entered or left French ports between Dunkirk and LeHavre could be sunk without warning. Hospital ships, passenger ships, and neutral vessels were excepted.

On the Flanders coast the work of the boats was made increasingly difficult in the summer of 1915 by the fact that in addition to the unapproachable and improved mine fields, the British had erected a net barrier at about the latitude of South Goodwin Lightship, which ran from there on bearing 110 degrees. This net was held up by large buoyant bodies, buoys, and flasks; and the submarines were forced to pass this barrier at night on the surface, as otherwise they would become entangled in the net. Since the enemy had to take care not to get into the net himself, a number of light buoys were attached to same, in addition to a number of warning beacons. In the course of time, these beacons became the most trusted friends of the Flanders submarine flotillas. They were all numbered, and were the greatest navigational aids in the passage of the Straits of Dover. Also, large unlighted buoys, which the enemy set out as navigation aids for his own vessels, were very advantageous to the submarines; one at Lat. 51°–20′.6 N, and 2°–7′.2 E was a large latticework buoy which bore the designation "Tonne 2501," and was used as a range to steer by for all boats approaching from the north, attempting to pass the Straits of Dover. Boats lay on the bottom in the vicinity of this buoy, where they awaited the tide and favorable opportunities for passing the straits. It is astounding what dangers these small easily handled boats were able to avoid under experienced commanders. Thus, by self-schooling and experience the flotilla was brought to

a very high state of efficiency. In this period the *UC-9, UC-5,* and the *UB-26* of the Flanders boats were lost. The *UC-8* was interned in Holland after going aground near Terschelling. Beginning in 1916, the enemy counter measures against the Flanders boats became sharper and more effective. These were directed first against the mine layers, and later against all the Flanders boats, in that large nets with attached mines were placed fifteen miles from and all along the Flanders coast the nets being patrolled constantly for months, beginning in April, 1916. Aircraft and patrol boats which were guarding this net sought to force the submarines under, thereby chasing them into the net. The aircraft became an ever increasing source of trouble to our submarines.

One step on the road toward the resumption of cruiser warfare was the entrance of Bulgaria in the war on the side of the Central Powers. The chief of the General Staff, Field Marshal General v. Falkenhayn, believed the moment ripe for the resumption of cruiser warfare, inasmuch as there was little danger of other neutral countries declaring war after Bulgaria had come in on the side of Germany. The chief of the Admiralty, Admiral v. Holtzendorff, supported this view to the upmost. Von Tirpitz also favored this stand, stating that the moment had now arrived for a decisive campaign with submarines, as replacements had been made and further delay would be dangerous. The conferences between the naval and military leaders took place in the Ministry of War in December, 1915.

This was followed by two memoranda from the Naval Staff on January 7 and February 12. In these was expressed the expectation that with a drastic submarine campaign the English resistance could be broken inside of a half year, this specific interval being set as a result of a caustic question from the Chancellor v. Bethmann-Holweg. The danger of a break with America was considered squarely, but opposed to this was the view that in any event the war must be concluded by the fall of 1916, since otherwise the possibility of obtaining favorable peace terms would have vanished. The second memorandum was sent further to a number of technical and industrial experts, who agreed that the resumption of unrestricted submarine warfare would bring to Germany the only possible assurance of success.

The Kaiser himself, in a decisive address at Wilhelmshafen on March 6, 1916, overruled the vote of General v. Falkenhayn

for the resumption of unrestricted submarine warfare in certain well defined areas. (Neutrals and others to be sunk without warning in individual cases, hospital ships and such excepted.) Tirpitz, who had been striving for a decisive submarine campaign, was ignored by not being invited to attend. This was followed on March 17 by the resignation of v. Tirpitz. History has shown him to have been right. Even had America declared war against us immediately, there is no doubt but that the counter-offensive measures at the disposal of Great Britain at that time were far less than those at the time when the unrestricted warfare was actually decided upon on February 1, 1917. There were relatively few armed merchant vessels at first. How much time would have been required to assemble and mount the 20,000 guns, which according to our calculations would have been necessary to arm all the enemy steamers?

Jellicoe's idea of strewing the German Bight with mine fields, was shattered because at that time no suitable type of mine for such an offensive had been developed. This was first accomplished in 1916, whereupon 100,000 mines of this type were ordered. These would not have been effective before the end of 1917, according to Jellicoe's own estimate, by which time we should have, in all probability, won the war with a decisive unrestricted submarine campaign. Hundreds of enemy patrol boats and chasers were in the process of construction. They were completed in 1917.

A further question is whether we ourselves had a sufficient number of submarines available in March, 1916, to begin such an unrestricted cruiser warfare. The list of available submarines, as of March, 1916, was as follows: In service, twenty-five large and forty-three small boats, under construction; nearly ready, fifty-two large and eighty-nine small boats. The twenty-five large boats were, with three exceptions, completely fitted out and manned by war experienced personnel. The boats which were designated as about to be completed were being finished with unprecedented rapidity. The monthly quota of commissioning was never so favorable as between April 1, 1916, and January 1, 1917.

The monthly rate of commissioning in 1916 was as follows: March, nine; April, eight; May, nine; June, eight; July, nine; August, ten; September, ten; October, eleven; November, eleven, and December, fifteen. Such a favorable increase in the rate of construction was brought about by the efforts of the Submarine

Bureau from November on. Due to these efforts, the average monthly rate would have been about twenty-seven boats both large and small from November, 1918, to November, 1919.

Although a renewal of the unrestricted submarine warfare was prohibited by the Kaiser's order of March 6, 1916, still the efforts of the Commander-in-Chief of the Fleet (Admiral Scheer since January 15, 1916), the Admiralty and Naval Staff were not without results.

After orders had been issued on the eleventh of that month that armed merchantmen were to be treated as warships, February 24 saw the reopening of cruiser warfare on the west coast of England, where the old stations on the south coast of Ireland were to be resumed. It is noteworthy that throughout the years 1915, '16, and '17, it was always the month of February that brought some decision as to the use of the submarine. This is no coincidence, since this month always brought with it the hope of renewed success with this weapon, as the spring promised better weather conditions and opportunities.

On February 24, the Commander Submarine Flotillas, Commander Bauer, gave the submarine commanders their instructions for the resumption of the cruiser warfare, a method of procedure which did not differ essentially from the rules for prizes. Hope was revived in the various submarine commanders that some effective use might at last be made of their branch of the service, but the fact that this restricted form of submarine warfare was to collapse after two months was veiled by the future. Toward the end of the month, the *U-22* and *U-32* stood out to sea for the west coast. Until the end of April, the cruiser warfare in the North Sea showed promising results.

Sinkings of from 200,000 to 300,000 tons were achieved by the *U-70,* under Lieutenant Commander Wunsche, the *U-44,* under Lieutenant Commander Wagenfuhrer, the *U-69,* under Lieutenant Commander Wilhelms, the *U-66,* under Lieutenant Commander v. Bothmer, and the *U-20,* under Lieutenant Commander Schweiger. The month of April showed results of 86,455 tons, which gave great promise for the ensuing summer months with improved weather conditions.

In Flanders, the order for the resumption of cruiser warfare coincided with the arrival there of the new improved type of boats. The *UB-18,* Steinbrink, and *U-B-29* put to sea for pioneer

work on the far side of the Dover Calais Straits. But just at this time came one of those unfortunate episodes in our conduct of the submarine war—the sinking of the steamer *Sussex* by the *UB-29* on March 24, 1916. According to her painting and the large number of troops on board, the submarine commander was forced to conclude that she was a troop transport. Since she was a passenger vessel, and the investigation was able to establish with certainty that she had been torpedoed, it gave the English further opportunity to instigate another note from America. This note exchange dragged on for about a month, and resulted in the famous "knockout" note which declared that submarines must carry on warfare in accordance with the rules for prizes.

Even while negotiations over this were in progress, Admiral Scheer, as commander-in-chief, had stated as his opinion that the submarine warfare should either be conducted unrestrictedly or the boats used for purely military purposes; but in no case in accordance with the prize rules. This sentiment was echoed by all submarine officers of experience at the front, and it was hoped that in some manner a decision would be reached which would put an end to the eternal vacillation of the leaders. The commander of the Flanders flotillas supported the view of the commander-in-chief, and one of the most experienced submarine officers, Lieutenant Commander Schweiger, *U-20,* stated in a report that he was extremely pessimistic over the results which were possible in accordance with the rules for prizes, as pertaining to submarine operations. So long as one could hope for the cancellation of the order of April 25 (cruiser warfare according to the rules for prizes) there was a possibility of achieving results under the orders permitting sinking without warning of all vessels in the blockaded area (with the exception of hospital ships) which came under the designation of warships, transports, or armed merchantmen. As for other areas, the rules for prizes could be accepted. As it was seen, however, that the political leaders were to accept the Wilson note, the submarine commanders in the North Sea flotilla and in Flanders changed their opinion. Strictly "military service" for the thirty North Sea submarines meant practical inactivity since two years of war experience had shown the impossibility of coming to grips with the British Battle Fleet. Flotilla commanders and commanding officers were therefore anxious to have the order changed. It was further proposed that submarine

warfare in accordance with prize rules outside the area of enemy patrols might be carried on with good results in case a steamer were halted at a great distance, approached submerged and finally boarded and searched, using another steamer to assist in the search, thus reducing the risks to the submarine. This suggestion made some impression at Wilhelmshafen, but the Commander Submarine Forces, Commander Bauer, had to put to sea on a cruise to the English coast with the *U-67*. His suggestions were handed over to the commander-in-chief on his return, who forwarded them on to the Admiralty. The Chief of Operations for the Fleet, Captain v. Levetzow, was at this time in Berlin. On his return, he brought with him such decided views on the conduct of submarine warfare as expressed by the Admiralty and the Naval Staff, that the commander-in-chief was forced to disapprove any measures for submarine operations which were not in strict accordance with the previous order which tended toward more intensive operations. Thus, this plan for submarine warfare in accordance with prize rules was vetoed.

In spite of the refusal of the commander-in-chief to permit further commerce warfare, the Admiralty could still have ordered it; this, however, did not occur and the months of May, June, July, August, and September, 1916, were lost as far as commerce raids in the North Sea were concerned. The decrease in tonnage sunk due to the suspension of operations must be estimated conservatively at 1,200,000 tons in the North Sea and 400,000 tons in Flanders. There are certain officers among us who estimate that the failure to continue the submarine offensive under prize rules cost us 1,600,000 tons as a certainty. Since the war even former enemies have stated that the suspension of submarine operations in 1916 proved to be the salvation of England.

An early summer lay over the waters of the German Bight as the submarines, returning from their last raiding cruises and overhaul periods, assembled at their bases. In accordance with the policy to use the boats for "strictly military purposes," long intervals of time elapsed while the boats waited at their bases for preparatory movement orders. As the British Fleet began their offensive on May 2 and 5 to support a seaplane attack from the vicinity of Horn Reef, *U-24* was able to make contact with the British battleships. Efforts made by this boat to call the *U-51*, *U-70*, and *UB-22*, which were in the vicinity on patrol in order to

bring them into position for attack, failed. Meanwhile, the *U-24* failed to attain position owing to the fact that the coupling between Diesel engine and electric motors was on fire, and sufficient speed could not be maintained to follow.

Patrol cruises in the North Sea early in May carried out by boats acting independently brought no results. In the early part of May, 1916, the plans of the commander-in-chief to deliver a blow to the British Fleet were matured. The original plan as worked out was to attack the English coast in the vicinity of Sunderland, thus bringing the enemy out from his bases and to engage him in the vicinity of the Firth of Forth, or to the southward of this point. In preparation for this contemplated attack, scouting operations were to have been conducted on a large scale in the North Sea between England and Norway. Following this, the submarines were to take station in the vicinity of the enemy bases, in order to attack the British Fleet when entering or leaving port after they had been drawn out by our fleet. Boats were to be stationed by the Orkney Islands (Scapa Flow), the Firth of Moray, the Firth of Forth, and the mouth of the Humber, while other important strategic positions were occupied near the Terschelling Lightship. Meanwhile, the Flanders boats were to occupy stations near the Thames and the Hoofden. Thus, the plan was painstakingly and carefully prepared. In accordance with these plans the boats soon put out to sea.

On May 13, the *U-74* stood out on her mission to lay a mine field near the Firth of Forth, extending on course from Bass Rock to the south and eastward. On May 17 the *U-43, U-44,* and *U-52* took up scouting positions in the northern North Sea. On May 18, the *U-24, U-23, U-63,* and *U-70* stood out. On May 20, the *U-47* stood out to sea; her mission being to make a final scouting cruise toward the coast near Sunderland for the purpose of locating mine-free routes for the fleet, checking the aids to navigation and observing the commercial traffic, after which she was to take station near Kinnaird Head.

The *UB-21* and *UB-22* proceeded on May 21 to the Humber, the *UB-27* to the Firth of Forth, in order to take station near May Island to attack warships, and the *U-72* proceeded to the Firth of Moray to lay a mine barrier on course, Stotfield Head toward Kinnaird Head.

On May 22, the *U-46* and *U-67* took up their stations near Terschelling Bank. The Commander Fourth Half Flotilla, Captain Prause, took passage on the *U-67* in order to direct operations in case several boats were engaged. These boats had skirmishes for eight days with enemy submarines which passed Terschelling Light on their way to the German Bight. Also, destroyers and speed boats were sighted frequently by them. The condition of both personnel and material was excellent in these boats; a fact that was to stand them in good stead later.

On May 23, at 2:00 A.M., the *U-47* reported to the commander-in-chief that the fleet need have no hesitation in approaching the coast at the point planned. Admiral Scheer, however, was not able to make use of this fortunate circumstance, because the weather continued to be too severe for airship scouting until May 30. The admiral did not deem it proper to dispense with the advantage that air scouting would give him, as he would then be fighting the enemy in their own waters and could only rely to a small degree on the scouting reports from the submarines. As regards the opportunities for submarine successes, this decision not to engage near the enemy coast was much to be regretted, since in that event, there was every probability that the submarines could make contact. Admiral Scheer waited until May 30 in the hopes of favorable weather, but at that time was forced to bring on the action if the submarines were to be utilized at all. Then the decision was reached to steam to the northward toward Skaggerak, the fleet supporting the light craft which were to engage in commerce raids. There are still a few of the preceding events to relate.

On May 28, the *U-72* reported that owing to a breakdown of her fuel oil pump she was not able to fulfill her mission of laying a mine barrier near Moray Forth. On May 29, the *UB-27* returned to port from her cruise to the Firth of Forth. Cruising submerged she had explored the Kirkaldy Bight and the coast as far as Inch Keith, without sighting enemy warships, but had made contact on May 24 with four old armored cruisers and destroyers near North Carr Light. This boat had been caught three times in nets and the port propeller was foul.

On May 30, at 8:00 A.M., the *U-46* returned to the Ems from her position near Terschelling Light, with her only periscope badly

damaged. Lieutenant Commander Hilebrand had therefore been obliged to abandon his station. He reported numerous floating mines near Terschelling Bank, many enemy submarines, and had been attacked once with gunfire and once with torpedoes by enemy submarines. In view of the general situation, the *U-46* was sent immediately to the Ems mouth for renewal of her periscope.

During the night of May 30-31, the fleet put out to sea. At 7:00 A.M., May 31, the *U-32* reported from her position 155 miles east of the Firth of Forth, two large battleships, two cruisers, and destroyers on course S.E. At 9:00 A.M., a report was received from the *U-66* of eight battleships, small cruisers and destroyers in a position sixty miles east of Kinnaird Head on northerly course. The *U-66* attempted to attack but could not obtain position for a shot owing to strong screen.

From these reports, it was apparent that the enemy light cruisers were out in force, and that the fleet had made contact with enemy ships. At 10:00 P.M., signal was sent by commander submarine forces for all available submarines at the Ems and the *U-67* to proceed to the northward and report positions at 6:00. The *U-67* could not be communicated with, as she was on the bottom, submerged, resting from her two weeks' activities. At 11:45 P.M., the *U-19* and *U-64* left the Ems.

At 6:00 A.M., the *U-46* left the Ems mouth to join the attack to the northward. No one dreamed at the time that this, the last boat to stand out, would be the only one to come to grips with the enemy battleships. While the first three boats were searching for the sunken cruiser *Elbing* on orders received from the commander-in-chief at 8:57 A.M., our radio direction finding station reported a damaged English ship about eighty miles west of Horn Reef, on course WSW. Since the *U-46* was already on a favorable course, she was ordered to stand on a course to intercept this vessel. At 12:30 P.M., the *U-46* sighted the enemy, which was the battleship *Marlborough*, torpedoed in the action on the previous day, and standing in toward her dockyard, convoyed by a destroyer. Since the *Marlborough* was on a retiring course, the *U-46* could only close to about 3,000 yards. At the moment the shot was fired the ship turned out six points and the torpedo missed. No opportunity presented itself for another shot. It was very unfortunate that the commanding officer set a course to proceed to the northward to reach the scene of the battle instead

of maintaining contact with the damaged ship which could only make twelve knots; since then he could have called the Flanders boats or the *U-67* to the attack. The latter sought the *Marlborough* without support from the *U-46,* but since contact was lost the search was in vain.

All other efforts to bring the submarines into the engagement proved fruitless. The *U-19, U-22,* and *U-64* received orders to proceed toward Peterhead and Scapa Flow, but encountered very heavy weather and were forced to turn back, although on June 2 they were in the same latitude with the British Fleet, but to the westward. The *U-46* was ordered to proceed toward Flamborough Head and sighted four small cruisers and ten destroyers, but was not able to assume position for attack; nor were the other submarines able to attack the British Fleet entering their ports as this was done in the night of June 2-3.

Thus, the battle of Jutland brought no opportunity for the submarines to attack, in spite of the vast preparations and the long and energetic efforts made while lying off the enemy coast. Even the Flanders boats, which were disposed to cover the Thames ports, sighted only patrol boats, and obtained no results. In the submarine service one heard the opinion expressed after the battle that the submarines should have been employed on the field of battle, a plan of operations which might have brought success, since the enemy squadrons, in carrying out the zigzag courses, usually remained in the same vicinity. Sending the boats out about twenty-four hours ahead of time and establishing several lines of submarines near the fleet covering the area between Skagerrak and Horn Reef would probably have given the boats some opportunity for attack. At the same time, it would not have been easy for the submarines to maneuver submerged and distinguish between friend and foe in the mist and smoke; further, the heavy artillery fire and the swift destroyer attacks would have forced some of the boats to seek safety at greater depths. On the other hand, there would have been numerous opportunities for attack in the extensive field over which the submarines might have been disposed; and as it turned out, it might well have been feasible to attack those units of the British Fleet which could not engage at the height of the action, as well as the retiring squadrons which were withdrawing to the northward on June 1. However, the spirits of the submarine service were again revived on June 6

when it became known that the cruiser *Hampshire* with Lord Kitchener on board had run on a mine field which was laid to the westward of the Orkney Islands by the *U-57*, under Lieutenant Commander Beitzen.

After the battle of Jutland, the submarines were employed for the most part on patrol duty near the exits from the German Bight, as it was generally believed that the English would attempt to re-establish their title to supremacy of the seas, which had been challenged at Jutland, by a powerful concerted attack on the German Bight. This, however, did not occur. No successes against men-of-war were obtained by the two lines of submarines which were established on wide arcs in the North Sea from July 3-13 and from July 28 to August 4. On their own initiative, the submarine commanders renewed the war on merchant shipping. Since few opportunities offered in the North Sea from June to August, four of the large boats were detached to service in the Baltic by orders from the Admiralty. There they became unaccustomed to the methods of cruiser warfare as practiced in the North Sea; a fact which was particularly noticeable when these boats returned to the North Sea at the time unrestricted submarine warfare was renewed.

In Flanders, the mine laying operations were continued with vigor on the east coast of England, and near Havre, Boulogne, and Cherbourg, by the newly commissioned *C-11* boats continuing until October, 1916. In this manner, 70,000 tons of enemy shipping was destroyed in the summer months of 1916. For the rest, this period in Flanders was marked by the stagnation caused by the order of April 25, suspending commerce raids, a situation which could not be remedied by the efforts of the flotilla commander. The small *B* boats conducted a strenuous warfare near the enemy barrier on the Flanders coast, and destroyed the buoys and navigational aids, which were continually being replaced. Navigation was difficult for the newly arrived *B* and *C* boats, as well as for the destroyers of the eleventh flotilla which were supporting the submarines. Operations near the mouth of the Tyne, conducted by the *B-11* boats, brought no remarkable success, either against warships or merchant vessels. As the chief of the General Staff demanded about the middle of July that special effort be made to hinder the transport of troops in the English Channel, the flotilla commander sought to enhance the results of the

submarines by extensive mine laying operations near the French coast; and reported, further, that greater results could be obtained provided the order against sinking without warning were revoked. To support these contentions, the submarine commander in Flanders, Commander Bartenbach, ordered the *UB-18,* under Lieutenant Commander Steinbrink, on a scouting cruise to the mouth of the Seine. All told, Commander Steinbrink made forty-one approaches in daylight, but failed to fire a single torpedo because it was impossible to determine the character of the vessel approached, either by her markings or by the mass of troops assembled on deck. Under the then prevailing orders, Commander Steinbrink could only sink seven small steamers and ten sailing vessels. As the chief of the Admiralty visited Zeebrugge on August 7, 1916, Captain Bartenbach, as a result of this cruise, argued in favor of an area between the lines Cape de la Hogue, Portland, and Calais-Downes, in which vessels might be sunk without warning when on a north or south course. As a result of this argument, an answer was received from the Admiralty stating that the situation in the summer of 1916 was not so critical as to warrant a break with America, and that until further orders not even transports should be subjected to attempted torpedoing without warning.

Admiral Scheer decided on August 19 for another operation against the English east coast. This time the experiences of the battle of Jutland were to be made use of in a fortunate manner, in so far as pertained to the employment of submarines. The boats proceeded to sea shortly before the fleet, during the night of August 18-19, in order to occupy stations in the morning, consisting of two lines of submarines; one line of four boats near Flamborough Head and a second line of six boats to the northward in the latitude of Blyth.

The large number of vessels proceeding to sea from the German Bight was reported to the English commander-in-chief by the submarines on patrol duty; and Admiral Jellicoe states in his book that he deduced from the reports the fact that the German Fleet was about to engage in large scale operations, and he thereupon left Scapa Flow with the fleet on August 18. At daylight, on August 19, he was in the latitude of the Long Forties. As early as 7:00 A.M., on August 19, the screen of light cruisers encountered the submarine line near Blyth; whereupon it fell to the *U-52,* under Lieutenant Commander Walter Hans, to sink the

cruiser *Nottingham* with three torpedo hits. Soon the *U-53* made contact with the British main fleet and was able to report position and course of same continuously. In this manner, Admiral Scheer was constantly informed of the disposition of the enemy forces, as well as by the numerous airships which accompanied the fleet. Unfortunately, a report from the *L-13* at 2:20 P.M., caused Admiral Scheer to abandon his original plan of operations against the English coast and to turn to the southward to engage what was reported to be a "force of large warships." The *L-13* was mistaken in both the location and the strength of forces reported. It proved later to be the Harwich Force under Commodore Tyrwhitt, consisting of the most modern light cruisers, and had Admiral Scheer found them he would not have been able to engage on account of their superior speed.

In the early afternoon, the line of submarines to the southward sighted the smoke of the British forces. The *U-49* and the *U-66* steamed to attack. Toward 6:00 P.M., the *U-66*, Lieutenant Commander v. Bothmer, was able to attack the small cruiser *Falmouth;* but although the vessel was struck by two torpedoes she did not sink. The *U-66* and the *U-49* then tried to finish off this ship, but owing to the good screening of the destroyers this could not be accomplished before darkness set in. Only the next day did this ship fall a victim to torpedo attacks by the *U-63*, under Lieutenant Commander Schultze.

This was the most perfect case of cooperation between the fleet and the submarines ever attempted. Lord Jellicoe expressed his astonishment that the submarine trap as exemplified by these operations was not made use of earlier in the war. His views were shared by Captain Bauer, commander of submarine forces, who had expressed this wish since the beginning of the war.

Following up these operations, attempts were made to use the submarines against enemy warships during and in conjunction with aircraft attacks on the east coast of England, but without result. In the meantime, toward the end of August, Captain Bartenbach decided to send his *B* boats to the western end of the channel to conduct cruiser warfare in accordance with prize rules, since he could not obtain authority for unrestricted warfare on transports in the straits, and did not want to keep his flotilla idle. On September 1 the *UB-18*, under Steinbrink, the *UB-23*, under Voigt, the *UB-29*, under Pustkuchen, and the *UB-39*, under Werner,

stood out to the western channel. This opening campaign brought results of about 70,000 tons. Thereupon Captain Bartenbach sought to achieve even greater results against enemy shipping along these lines, even though operations were not very promising owing to the patrols (convoy), the arming of merchantmen, and the fact that boarding and searching transports was out of the question. They were further hindered by the low surface speed of these boats—barely nine knots—and the fact that they were armed with only 5 cm. guns. A re-armament of these boats with 8.8 cm. guns was immediately undertaken.

This decision of the Flanders flotilla influenced the North Sea flotilla to such an extent that during the operations against warships in September and early October, these boats began commerce raids on their own initiative to a greater or less extent. Thus, the *U-57,* under Lieutenant Commander Georg, sank a large steamer and twenty-one fishing vessels, near Flamborough Head, while the *U-49,* under Lieutenant Commander Hartmann, sank three sailing vessels and sent in one prize to the Ems.

These deeds were, however, not alone inspired by the activities of the Flanders flotilla, nor the results of the operations in the Mediterranean, but by another event of great importance. Hindenburg and Ludendorff had been appointed to the supreme command of the Army. These two leaders realized that if a decision was to be obtained, the most energetic employment of the submarines was essential. As early as August 30 conferences were held at Pless between the military leaders and the chief of the Admiralty regarding the renewal of unrestricted submarine warfare in the North Sea and Flanders. The Chancellor, v. Bethmann Hollweg, professed to believe that this would bring Holland and Denmark into the war. Although these fears were somewhat farfetched (our attaché at the Hague, Captain v. Muller, and others denied any such danger) the military leaders decided to postpone the opening of unrestricted submarine activities until the situation in Roumania could be sufficiently cleared up to permit the mobilization of defense corps near the borders of Holland and Denmark. The fact remained that the idea of unrestricted submarine warfare was favorably considered and only the question as to the time for commencing it held in abeyance. It is tragic to note, however, that the decision as to new construction was not made at this time.

Up to this time, the orders for a large number of certain types of submarines had been purposely avoided, since the continuous changes in the methods of employment of these boats prevented the selection of a definite suitable type. Further, the decision was held in abeyance until certain new types which were being used at the front could demonstrate their fitness before orders for them were placed on a large scale. Now these obstacles no longer existed. A large number of certain series should have been immediately ordered. Only in this manner could a full exploitation of the technical experience of the dockyards and the industries which supplied them be obtained. At all events, the dockyards building merchantmen should have been drawn into submarine construction at an earlier date. Particularly fateful was the decision of the Secretary of State for the Navy, v. Capelle, which was influenced by the fact that after the war a large number of submarines would be decidedly disadvantageous for the administration and the further expansion of the navy as a world power. The director of submarines in the Admiralty, Commander Spindler,[1] in spite of urgent representations on his part, was only permitted to order new submarine construction after many delays, hindrances, and refusals. It should have been the other way around, i.e., the secretary should have expressly ordered the fullest utilization of the dockyards for new construction.

Thus it came about that after the conference at Pless in 1916 only two 800-ton boats, sixteen 400-ton boats, and nine submarine cruisers were ordered. In anticipation, it should be remarked that the orders for new construction in February, 1917, of six 800-ton boats and forty-five 400-ton boats were insufficient for the operations contemplated by the order of February 1, 1917, for unrestricted warfare. Not until June and December, 1917, were large scale orders placed with the dockyards, due to pressure from the front. These were as follows: June, nine 850-ton boats, ten 2,000-ton boats, thirty-seven 500-ton boats, and thirty-five 450-ton mine laying boats; in December, twelve 850-ton boats, thirty-six 500-ton boats, thirty-four 450-ton mine laying boats, and twenty 350-ton single hull boats. Even these could not be considered a large scale building program. This point will be discussed later on.

The dispatch of the *U-53* to America and the receipt of orders on September 15 for three boats to proceed to the Polar Sea,

[1] Editor's Note—An article on submarines, by Rear Admiral Spindler, will appear in the May issue of the Proceedings.

broke in on the monotony of the apparently useless "strictly military employment" of the submarines, and revived the hopes of the flotilla.

The *U-53* proceeded on this duty on September 17, her primary mission being to attack the warcraft which were supposed to be near the entrance of Long Island Sound, waiting for the submarine merchantman *Bremen*. In addition to this, the *U-53* was to carry out commerce raids in accordance with prize rules. On October 7 the *U-53* entered Newport harbor. On the same day she proceeded to sea after an exchange of official courtesies. On October 9 she attacked and sank five English and neutral vessels, carrying contraband, near Nantucket Lightship, while American destroyers looked on and assisted in the rescue of the crews. On October 28, the *U-53* arrived in Helgoland in good condition.

The *U-43*, *U-46*, and *U-48* operated near the North Cape and along the Murman coast. They succeeded in sinking about 50,000 tons; and in addition the *U-46* brought in to Wilhelmshafen a steamer carrying munitions and automobiles valued at forty million gold marks. While these boats were still at sea, on October 6 orders were received for the resumption of commerce warfare in accordance with prize rules, such as was already in full swing in Flanders, on the initiative of Captain Bartenbach.

It should be stated that the following period, up to February 1, was particularly favorable. New commanding officers on the *U-49* and *U-50* achieved sinkings amounting to 40,000 tons in the Bay of Biscay, while the older experienced commanders were equally fortunate. Sufficient experience had been obtained to equalize to some extent the hindrances resulting from the restricting operations orders. Thus, the commanding officers took steamers with them for the safe keeping of the crews of captured vessels, until the latter were filled up and could be sent into port. By skillful maneuvering the operations could be carried out outside the zone of enemy patrols. Results obtained near Cape Finisterre and further to the southward were particularly gratifying.

In Flanders the commerce warfare could only be carried out in accordance with prize rules by the *B-11* and *C-11* boats in the western approaches to the channel; and such operations did not offer such favorable opportunities as with the large North Sea boats which could choose their own field of operation. The small *B-1* class of boats could not be used effectively in this type of war-

fare. Of especial note were the results accomplished in Flanders by the following officers: Lieutenants Wassner, Loss, Howalk, Viebag, Salzwedel, and Hunius, as well at the previously mentioned older officers.

After wearisome negotiations between the military and political leaders, on January 9 authority was granted to submarine commanders to attack armed merchantmen without warning; and this was followed on January 12 by the decision to commence unrestricted submarine warfare, the time for the beginning of the latter being set at February 1, 1917.

In spite of the lateness of the date set, the decision for unrestricted submarine warfare was greeted with joy at the front in that it appeared as an end of the continual vacillation of policy which existed up to that time; even though many a justified doubt was expressed as to whether or not it was too late in coming and whether the submarine service was sufficiently equipped from a material standpoint for such extensive operations.

Unfortunately, the declaration of the unrestricted warfare carried with it a bomb. This lay in the fact that in the spring of 1916 the Naval Staff had expressed the hope that with such means the English resistance could be broken in six months. This declaration had two consequences, viz.: (1) It led to a certain tension at the front, since, if the Naval Staff really believed by such means to end the war in six months, it followed that every boat should be made available in the shortest possible time and overhaul periods that would have been necessary for a longer period of operations should be very much shortened or abandoned. This principle appeared to justify the most extreme employment of the submarines.

With this in view, the idea was evolved in the North Sea flotilla, to attempt the passage of the Dover Straits as the quickest means of proceeding to the attack, although since April, 1915, this route had been abandoned by all but a few of the North Sea boats. At all events, the Flanders flotilla had had considerable experience in passing the Dover Straits and were constantly able to overcome the renewed difficulties which were made by the enemy in the Channel. On these grounds, Captain Bartenbach advised the route through the straits for the North Sea flotilla. Thus, with the opening of the unrestricted warfare, about 50 per cent of the time this route was utilized in passage to the west coast of England.

Great success was obtained in this manner by individual boats, particularly the *U-85,* under Lieutenant Commander Petz (December 17, 50,000 tons) and the *U-53,* under Lieutenant Commander Rose (March 17); while on the other hand, many of the boats encountered considerable difficulty in the passage of the Channel, and owing to weather and other unfavorable conditions held to the northern route around Scotland. As the conditions for the northern route improved in March, the commander of the North Sea flotilla ordered this route to the northward of England for all large North Sea boats, as the usual method of procedure. His desire personally to explore operating conditions in the Channel on one of his boats was refused by the commander-in-chief, but his measures to avoid losses proved correct, since they were taken before any appreciable loss occurred.

(2) The hope of the Naval Staff to bring the war to a conclusion in such a short time halted the large scale building program. It has already been stated that the declaration for the unrestricted warfare found the submarine service considerably short of the required number of boats to carry out operations on such a large scale. Admiral Capelle said himself that he could not, under those circumstances, agree to the construction of a large number of boats which could not be completed within one year's time. By this sharper form of submarine warfare, the sinkings were noticeably increased from the start. In February they were double what they were in January, while in April and June they reached nearly a million tons.

In the North Sea area during 1917-18, the following officers achieved notable results: Lieutenant Commanders Schweiger, Rose, Wunsche, v. Georg, Adam, Dichman, and many others who cannot be mentioned in the limited space of this article.

England felt that she stood before a momentous decision and made extraordinary efforts to avoid the danger. Her counter-offensive measures toward the middle of 1917 took the following forms, viz.:

1. Further obstacles to the passage of the Dover Straits.

2. Increased net and mine laying operations near the German Bight. In the latter, the enemy obtained greater and greater practice. The fleet was engaged in greater activity in keeping clear the exists from the German Bight. Counter-mining was resorted to by

us. This led to the loss of a number of English mine layers, as shown by the British list of losses, while on the other hand, several of our submarines were lost. Thus, on May 14, 1917, the *U-59*, under Lieutenant Commander v. Firks, was lost on our own mine barrier near Horn Reef, as in the fog he missed picking up the navigational aids which were laid out to the southward. The best route from the Ems lay to the westward along the sand banks off the coast of Holland, where the German submarines were able to coast near the banks with very few navigational aids as far as the area of reported British mine fields. From the middle of 1917 on, the commander mine sweeping forces and the fleet attempted to keep a large area clear of mines from the Ems to the outer limits of the English mine barriers lying to the north and westward of the German Bight. As far as this area the submarines were to be safely convoyed by surface craft, then they were to submerge and pass the outer mine barrier under water. On entering, the reverse of this procedure was to be followed. This scheme worked successfully at first, but led later to losses after the English submarines on patrol off the German Bight had observed and reported on the methods in use; whereupon the British, instead of laying out mine barriers, resorted to a system of nets with mines attached, placed at different depths. In this manner, a number of competent officers were lost in September, such as Lieutenant Commander Schweiger of the *U-88* and Lieutenant Commander Berger of the *U-50*. Lieutenant Commander Hufnagel, on the *U-106*, was lost also on entering the German Bight on October 9, 1917. Since no decision was reached to undertake a forcible clearing of the barriers, the boats were forced to resort to the passage through the Baltic for the first time (standing out through the Little Belt and entering through the Sound).

From September, 1917, on, the new commander submarine force, Commodore Michelsen, decided to return to the route through the Dover Straits. On September 28, the *U-70*, enroute to the Dover Straits, was caught by the stern in a net-mine, but was fortunately able to be brought in to Zeebrugge. In November, the *U-48* and the *U-94* were set on to the Goodwin Banks by strong westerly currents, and failure of the gyro-compass. The *U-94* came clear after lightening ship, but the *U-48* had to be blown up by the crew. On the other hand, Lieutenant Com-

mander Rose, on the *U-53,* sank 28,000 tons on a thirteen-day expedition in October. After the unexplained loss in January of the *U-87* (Speth-Schulzburg), *U-84* (Rohr), *U-93* (Gerlach), and *U-95* (Brinz) during passage of the Dover Straits, and reports from the Flanders flotilla of additional barriers in the Channel, Commodore Michelsen thereupon ordered the route to the northward of England to be resumed.

3. One very effective counter-measure, which the English conceived during the height of our submarine activities in June, was the formation of merchant convoys. The assembly of from twenty to thirty merchantmen in convoys considerably reduced the opportunities for attack, and further rendered the attack technically more difficult on account of the convoying destroyers or other craft forming a protective screen. The convoy system was soon employed in all theaters of war, including the Atlantic Ocean, Mediterranean, and the North Sea, between the Shetlands and Bergen. The latter convoy traffic was so heavy that special submarine operations were directed against them. At first this was attempted with large boats, later with *B-11* boats, and finally attempts were made to disturb this traffic with surface craft.

Taken altogether, these counter-measures effectively prevented any increase in the sinkings over the maximum reached in July, 1917, although no very alarming falling off in the sinkings began to occur until May, 1918. However, the maximum sinkings of June, 1917, could have been maintained in spite of these counter-measures, had the number of boats at the front been increased. Had a building program been definitely initiated at the end of August, 1916, at the time when Hindenburg and Ludendorff decided on the unrestricted submarine warfare, the results would have been operative in the fall of 1917. On the other hand, the greatest number of boats available for use at the front in the North Sea, Flanders, and the Mediterranean, was 132 in September, 1917. From this time on, the number of boats varied from 110 in June, 1918, to 123 in October, 1918.

Under these circumstances, it is not to be wondered at that the personnel at the front began to consider seriously the question of speeding up submarine construction in the fall of 1917. The efforts of Commodore Michelsen and the commander-in-chief in this matter led to the establishment, in the latter part of 1917, of a separate independent department in the Admiralty for all matters pertain-

ing to the material, personnel, and organization of the submarine service. (Previous efforts for the establishment of this bureau had been made by the administrative officers in the Admiralty, without result.) The time for the creation of this bureau was favorable in so far as one hoped to be able to enlist greater support from the industrial workers in submarine construction after the collapse of Russia. Unfortunately, this hope proved to be vain, since the military leaders did not believe the time ripe to transfer large numbers of workmen to this field, owing to the impending offensive on the western front. In the Submarine Bureau, the question was debated as to whether or not it would not be more advantageous to utilize the labor set free by the collapse of the eastern front for intensive submarine warfare instead of a renewed offensive on the western front. At the same time, the troops released from the east front could be used to crush Italy, which would go far to support the submarine offensive in the Mediterranean, since the latter had been reasonably successful in itself. Since a similar conception already existed among certain military leaders in slightly different form, the chief of the Submarine Bureau, Vice Admiral Ritter v. Mann, undertook to lay the matter energetically before the proper authorities. Unfortunately, no consensus of opinion could be obtained among the naval and military leaders on this point. At that time, too much confidence was felt by the Admiralty in the supreme military command (Hindenburg and Ludendorff) for the naval leaders to attempt to oppose their decision in regard to any question of military policy. Therefore, the decision to undertake the western offensive remained. However, the chief of the Submarine Bureau was enabled by exerting pressure on the military leaders to obtain small drafts of workmen, and by a reorganization to obtain better delivery of material from the inland industrial works, thus avoiding delays in construction. Further, the bureau undertook a large scale construction of repair facilities at the bases in order to shorten the overhaul periods. At the beginning of April, large construction programs were initiated at Pola and Cattaro. One tragic episode was the fact that the Pyovica docks near Cattaro Bay were just completed when it became necessary to evacuate the Austrian ports. In the home waters, the following construction program was undertaken, viz., the expansion of the Holm docks in Danzig, the establishment of a base at Lubeck, another base at

Hamburg (now the Deutsche Werfte), and an expansion of the docks at Emden. As early as December, 1917, thirty large and ninety small boats were launched, and up to June, 1918, sixty-four additional large and 156 smaller boats. A number of dockyards not previously engaged in submarine construction were drafted into this work. Thus it came about that at the outbreak of the revolution 440 boats were under construction, of which 137 were the larger type, while 330 new contracts had been placed. Of these, 117 were large boats, which had been contracted for in September and October, 1918. For these contracts, negotiations were entered into with Hugo Stinnes, and the heads of the larger inland industries were called together in Berlin to arrange for a division of labor in such a manner that the overloaded dockyards could be relieved to some extent by the other industries. All of these extraordinary efforts of the Submarine Bureau were necessitated by the neglect in previous years. Thus, the bureau fought a losing fight, but as the delivery of thirty new submarines for service at the front became a certainty in September, 1918, the chief of the Bureau could feel that he had accomplished the maximum possible.

September, 1917, brought the opening of the submarine cruiser operations which are of sufficient importance to mention even in this abbreviated article. These were opened by the cruises of the *U-152*, under Lieutenant Commander Huesel, and the *U-151* under Commander Kophamel, both being former submarine merchantmen. These cruises lasted three months and extended in the Atlantic as far as the Azores, resulting in the sinking of 40,000 and 30,000 tons, respectively. These cruises were directed by the Admiralty and were particularly promising since they could be conducted in areas where few counter-measures existed. A particularly successful cruise was made by the former submarine merchantman *U-155*, under Commander Eckelmann (January 14 to May 4, 1918) from the barrier near the Azores to the westward of Gibraltar with results of 50,000 tons. Another of the *U-152*, under Commander Kolbe (December 23, 1917, to April 19, 1918) to the coast of Portugal and Africa and as far as the Canary Islands resulted in sinking 30,000 tons. As for the submarine cruisers, only two more came into service up to the time of the revolution: *U-139* and *U-140*. The *U-140*, under Commander Kophamel, was enroute to America from July 2 to September

20, 1918. This resulted in the sinking of about 30,000 tons. The *U-139* and the *U-140* were both hindered in their operations by leaks in the pressure hull and by poor stability on diving. Of the thirty-eight new submarine cruisers with two 3,000 h.p., Diesel motors, which were completed just before the revolution, none came into action; while the fast 1,200-ton boats, of which the *U-135* was the first to be commissioned, suffered the same fate. The new large mine laying boats of the *U-117* series to *U-126*, carrying up to twenty-four torpedoes and forty-two mines, were partly available for war service. The cruise of the *U-117* under Commander Droscher to the coast of North America, resulting in the sinking of 23,000 tons of merchant shipping, is worthy of note.

Undoubtedly, the three new types of submarines would have achieved extraordinary successes had the war lasted longer. The British regarded with great anxiety these new developments in the submarine weapon, and the greater possibilities which existed as a result of this expansion of submarine warfare. That these operations would extend far beyond the field of the British counter-measures was better understood in England than in Germany; hence their characterization that the Germans had given up their weapons "five minutes" too soon.

The previously mentioned falling off in the sinkings from May, 1918, on, is to be attributed in the first place to the fact that at this time the British obtained the upper hand in the submarine operations in Flanders. As early as January, 1918, the average monthly loss of boats in this area reached four. From April on, the docks at Zeebrugge were subjected to extensive air attacks. Any one who had visited the Flanders flotilla at this time knew that they were and regarded themselves as the right wing of the hard pressed western front; and that neither the Admiralty nor the flotilla commander would initiate anything to restrict the activities of this base. It was the spirit of Leonidas and his band of heroes that ruled in Flanders. On the other hand, a careful consideration of the efforts made against the results achieved must have decided the Admiralty to undertake the gradual dissolution of the Flanders flotilla. The losses to the service of valuable experienced personnel and material were not replaceable by any means. It would have been proper to have detached these *B-11* boats with their experienced commanders in the spring of 1918 and assigned them to the flotillas in the North Sea and the Med-

iterranean, respectively. After the commander submarine forces in the North Sea had abandoned the passage through the Dover Straits in February, 1918, a procedure had been established based on the experiences of Commanders Rose and Saalwachter, by which the average loss of boats did not exceed two per month.

Against this procedure, the great mine barrage laid by England and America, extending from the Orkneys to the Norwegian Coast, availed but little; only two boats are known to have been lost as a result of same, namely, the *U-156,* under Lieutenant Commander Feldt, and the *UB-127,* under Lieutenant Scheffler. It is not to be denied, however, that the threat of this barrage was extremely unpleasant.

The acceptance of the fourteen points of Wilson in October, 1918, brought an end to the commerce raids in submarine warfare. Once more the idea of joint military operations with the Fleet under Admiral Hipper against the enemy flickered and died out. (Admiral Scheer had in the meantime been appointed to the supreme command of the Navy.) It was too late. The collapse of our High Seas Fleet called back the *B*-boats which had assumed outlying positions for attack.

The submarine warfare did not bring the expected results, and we have learned the reasons for its failure. Although the war with the submarines was not successful, still it exerted a powerful influence on the future sea power in that it altered the conception of what constitutes this power.

PANAMA TIDES

By R. Z. Kirkpatrick, Chief Hydrographer, Panama Canal

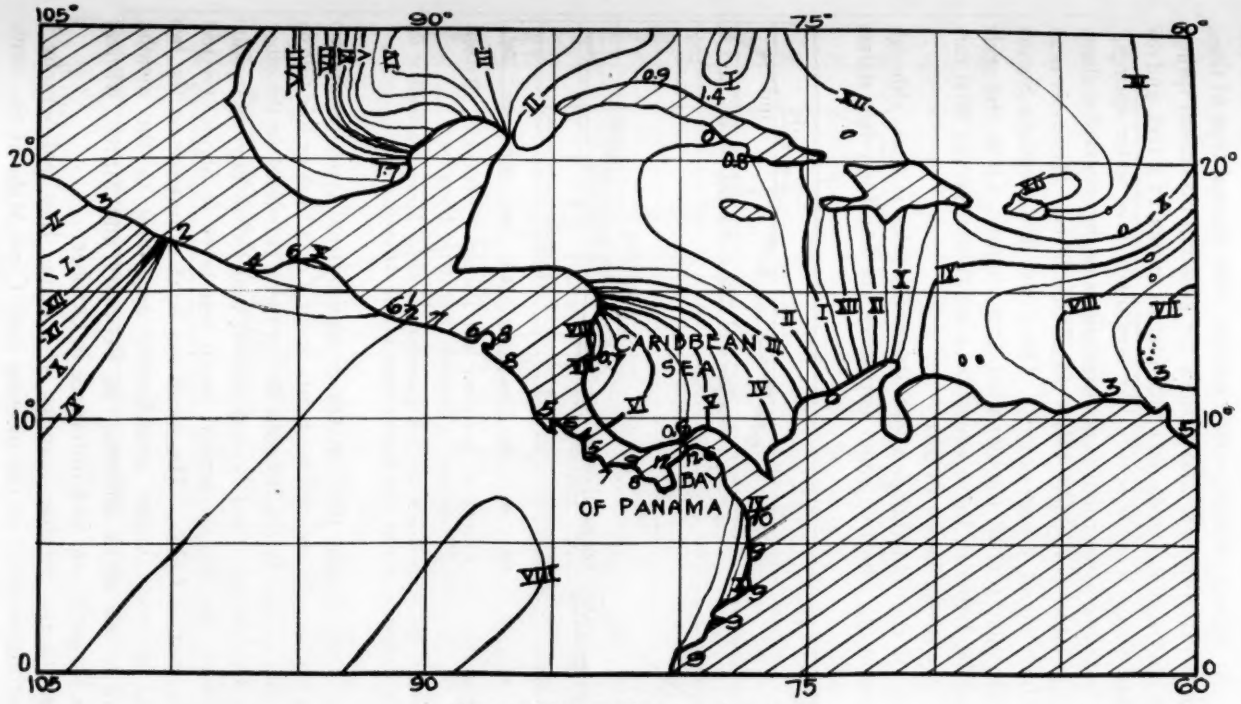
THE difference in tides on the Pacific and Atlantic entrances of the Panama Canal was once a moot factor in the arguments of the sea level *vs.* lock level controversy. The lock level advocates pointed out the necessity of a Pacific lock to offset the difference of tide level and resultant current therefrom, i.e., they declared an actual sea level canal was not feasible from the matter of tides alone.

There are now over sixteen years of American tide records available. Accurate sea levels have been determined and many values are now known that had to be approximated in the pre-construction days.

The Panama Canal transits a vessel from the Caribbean Sea to the Pacific Ocean, an oceanic distance of 10,600 miles, in thirty-eight nautical miles. Considering the more usually schoolbook assigned cause of tides alone, the attraction of the sun and moon, it might be expected that the tides at the Canal entrances would vary but slightly. But there are other causes, such as position and shape of land formations, ocean currents, prevailing winds, revolution of the earth (tidal ranges are usually the greater on the west coasts of continents), densities of sea water, and so forth.

Panama Bay is virtually a reentrant angle with a vertex 100 miles from the ocean proper—a very conducive reason for wide tidal ranges. All the year the winds over the Caribbean Sea are from the northeast, being strongest in the dry season from January to May; on the Pacific side the same winds are off shore in the dry season, but are largely from the southeast the rest of the year.

The Caribbean Sea is noted for its small tidal ranges. At Cristobal Harbor there is an average range of but 0.6 feet, with maximum ranges between plus 1.7 and minus 1.06, or 2.76 feet. Furthermore, it has the intermediate form of tides, i.e., part of the lunar month it has the semi-durnal type two highs and two lows

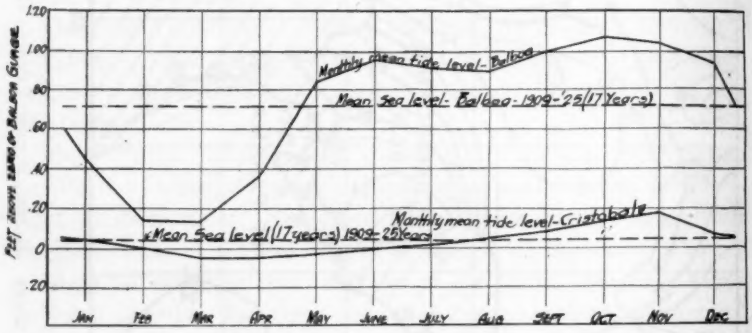


COTIDAL MAP OF CENTRAL AMERICA

NOTE: Arabic numbers denote average tidal ranges. Roman numbers denote Greenwich time of mean high water.

and ranging from that to the diurnal type of one high and one low. At Balboa Harbor, which has the semi-diurnal type of tides, the tidal variations are many times the greater; maximum springs range 22.3 feet, between plus 11.2 feet to minus 11.1 feet, and the average range is 12.6 feet. The so-called "low water springs," used as the reference datum for soundings on hydrographic charts and tide table, is 8.3 feet below mean tide level. Minimum neap tides have about 5 feet ranges. The Coast and Geodetic Survey estimate that for an unobstructed free channel 1,000 feet wide across the Isthmus, there would be a maximum spring tidal current of 3 to 3.4 knots an hour.

One of the odd things about Panama's tides is that, although geographically the two canal entrances are but forty-two statute

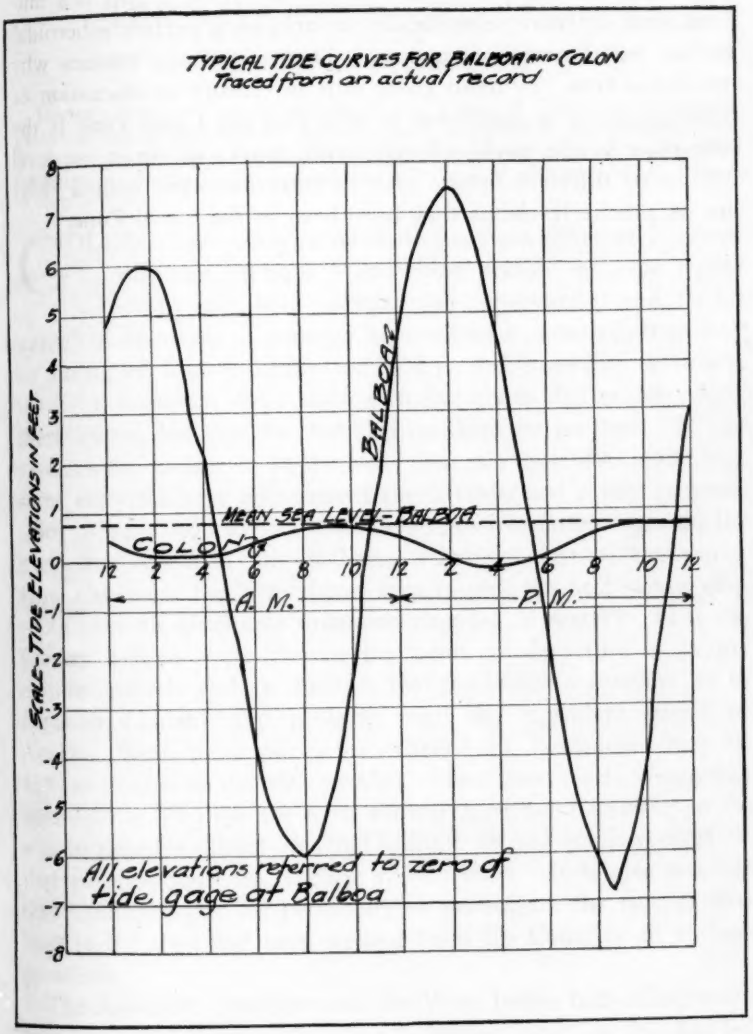


COMPARATIVE TIDE LEVELS AT ATLANTIC AND PACIFIC ENTRANCES. BALBOA-PACIFIC ENTRANCE. CRISTOBAL-ATLANTIC ENTRANCE

NOTE: Meantide levels are for calendar months. Mean sea level at the Pacific Entrance is .684 feet higher than at the Atlantic.

miles apart, similar tidal phases of semi-diurnal types on the two sides are usually about three hours apart, i.e., a high or low tide on one side usually is synchronous with a mean tide level on the other. (See Cotidal map and typical Balboa and Colon curves.) Furthermore, the Balboa annual mean sea level is about .68 feet above that of Colon. The mean sea level difference on the two sides, however, varies considerably according to the months. There is but slight difference in February and March, whereas there is nearly one foot difference in October.

One of the peculiar features of Panama Bay hydrography is the probable effect of the meeting near Cape Mala of the south-


TYPICAL TIDE CURVES FOR BALBOA AND COLON
Traced from an actual record
SCALE-TIDE ELEVATIONS IN FEET
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
BALBOA
MEAN SEA LEVEL-BALBOA
COLON
12 2 4 6 8 10 12 2 4 6 8 10 12
A. M.
P. M.
All elevations referred to zero of tide gage at Balboa

bound California current and the northbound so-called Humboldt current. The higher level of mean tides at Balboa is probably at least a partial effect of this.

The general impression that the surface of all oceans is a uniform level, or more scientifically, an area on a perfect spheroidal surface is, of course, erroneous. There are many reasons why this is not true. Without going into any theory or discussion of these causes, it is significant to note that the Canal Zone is the only place in the world wherein bench marks on mean sea level datums of different oceans may be interconnected with a short line of precise levels, as they have been in the Canal Zone.

THE NAVIGATION OF COLUMBUS

By Captain J. Menander

Editor's Note:—This article specifically treats of Columbus as a navigator; it will be remembered that an article appeared in the January, 1925, Proceedings, No. 263, by Commander L. J. Gulliver, U. S. Navy, entitled "Admiral Columbus" which maintained he was a seaman rather than a navigator.

COLUMBUS' ability to navigate has been differently judged by different authors. One thing stands out; the routes chosen by him, both outward and homeward bound, on his voyage of discovery of America have not been materially improved on during the four centuries that have passed, since they were first used. I, however, don't think that Columbus deliberately chose these routes, but that he stumbled on them by accident. If one assumes the former to be the case, then one must also admit that some early seafarer had crossed the Atlantic and safely returned prior to 1492, and imparted to Columbus his observations on the prevailing winds in this, hitherto unknown, part of the world. How else could the latter know how to pick the best sailing-ship route over an absolutely unknown expanse of water? That the Canary Islands were chosen for point of departure is in my opinion entirely due to the fact that Columbus wanted to go to Cipango (Japan) and probably visit the legendary island of Antilia. Both these places are marked on Toscanelli's map of 1474 as located on the 28th parallel. Since great-circle sailing was unknown in his time, the most natural thing for Columbus to do, was to take his departure from latitude 28 and continue west on that parallel, until he reached his objective. It is also possible that Columbus wished personally to investigate the rumors that land to the west had been sighted from the Canaries on various occasions.

The American continent and the West Indies had undoubtedly been visited by Europeans before Columbus' time, but this had led to no certain or permanent knowledge, and was in a short time again lost to mankind. Columbus' determination to stick to his

RESTORATION OF THE TOSCANELLI MAP

original plan to steer west, until he had reached Cipango and the Indies, was the work of a strong mind that triumphed over the ill will of his officers and the ignorance and superstitions of his sailors. He deviated from his predetermined course only when forced to do so by adverse winds, or when the flight of birds or other signs seemed to indicate the proximity of land, but he always returned to his original course, when the indications proved false.

When delving into the navigation of Columbus, one must take into consideration how inaccurate was his conception of the size of the earth, and how terribly crude the nautical instruments of his time really were. It was at that time, at least amongst educated people, known that the earth was spherical, but the size of the sphere was grossly underestimated. Columbus believed that

THE THREE VESSELS OF THE FIRST VOYAGE OF COLUMBUS
From an old map of Española. The drawing believed to be by the Admiral.

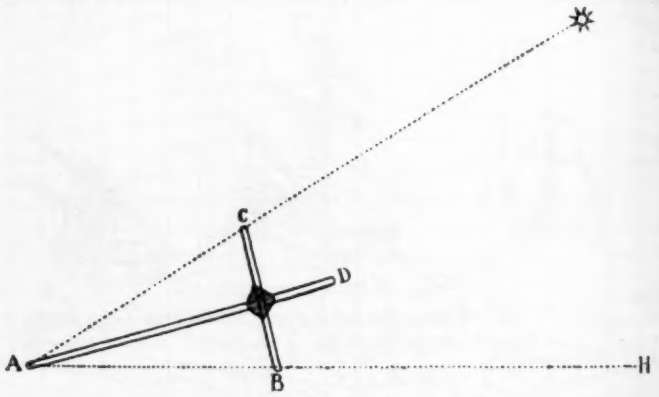
the circumference of the earth at the equator was 16,000 nautical miles, when it actually measures 21,600 nautical miles.

Columbus' original journal has been lost, but we have an abstract of it, made by his contemporary historian, Bishop Las Casas. This abbreviated narrative is unfortunately not compiled by a navigator. It is very inaccurate and faulty in matters nautical, and there are obviously pure clerical errors in the entries. It is not stated whether the courses given are magnetic or true, and it is impossible to tell what leeway his ships made, or if the courses are corrected for leeway or not. Columbus, however, seems to have ignored both the variation of the compass and the leeway, and doggedly stuck to his westerly course by compass. It is worthy of note that Columbus kept two reckonings: one for his own use, and the other for his subordinates. In the former he entered the day's run as estimated by him; in the latter the distances were always less.

RESTORATION OF THE TOSCANELLI MAP

Columbus had assured his men that they would find land 2,000 miles west of the Canaries, and he deliberately falsified his records, "because if the voyage was of long duration, the people would not be so terrified and disheartened."

The discoverer of the New World was favored by the fair winds and fine weather that have prevailed in this part of the world for several thousand years. Las Casas writes, "The admiral says that on that day (September 16) and ever afterwards they met with very temperate breezes, so that there was great pleasure in enjoying the mornings, nothing being wanted but the songs of nightingales. He says that the weather was like April in Andalusia." There seems to be a widely spread misunderstanding that Columbus' little flotilla was greatly impeded by the seaweed in the Sargasso Sea, and that his ships were for weeks actually imprisoned amongst the weed. The progress was slow, but it is plainly intimated in the narrative of the voyage that this was caused by calms and light winds. Columbus mentions the presence of seaweed on many occasions, often as supposed indications of land, but it seems not to have caused him the slightest worry.

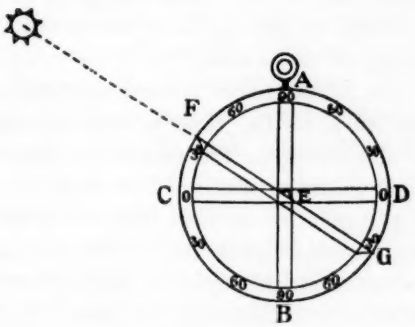


THE FORE STAFF OR CROSS STAFF

As far as the nautical instruments of that time are concerned, they were the most primitive imaginable. The charts were incorrect, not to say misleading, especially so when they purported to depict parts of the world that had never been visited by white men. Logs were absolutely unknown. The speed of the ship or the distance run was estimated or guessed at. The

lead lines were only about forty fathoms long, and of course absolutely useless as means of fixing position, since no soundings were given on the charts. The instruments for measuring the altitudes of heavenly bodies that had been invented up to that time, were the cross staff, the quadrant, and the astrolabe.* The former was a very clumsy wooden contraption, about thirty-six inches long, made of two battens, and exceedingly difficult to use. The graduation of this "instrument" was on the longer arm. The shorter cross arm was moved back and forth, until the observer, with his eye at A, sighted the horizon in line with B more or less simultaneously with observing the heavenly body in line with C.

The quadrant was of metal, two of the sides were straight and at right angles to one another. The third side was an arc with



THE SEA ASTROLABE

graduation to ninety degrees. Two sights were fixed on one of the straight sides, and a string with a weight was suspended from the center of the arc at the intersection of the two straight sides. When an observation was taken, the sights were aimed at the sun or star, and the altitude was read at the intersection of the plummet line with the graduation on the arc.

The astrolabe was the most modern instrument of that time. It was made of copper or tin, and from eight to twelve inches in diameter. The ring was graduated from C to A and B, and from D to A and B. An arm, FG, with sights, pivoted at the center, E, of the ring. When used, the astrolabe was suspended by the hand from A, and the weight of the instrument made the line CD take a

*The first reflection instrument to be really used at sea was invented by Thomas Godfrey of Philadelphia in 1730.

horizontal position. The movable arm, FG, was sighted at the heavenly body, and the altitude was read on either side of the scale, or perhaps on both sides, and the mean of the readings was used.

It is obvious how inaccurate these instruments were, especially if there was a sea or swell running. They either depended on the plumb line, or required the observer to look simultaneously in two directions, and it generally took three men to work the instrument. One held the astrolabe, the second sighted it, and the third read off.

The first chronometer was used in 1761, and there were no time pieces, as we know them, used at sea in the time of Columbus. The only means available for the measuring of time at sea was the half-hour sandglass, and we still strike our bells at sea in accordance with the number of glasses, as it were, that have run out since the beginning of the watch.

It is obvious that it was under these conditions absolutely impossible to keep track of the time of any standard meridian. Logarithms were not invented. The time of the ship was daily corrected by judging it from the position of the sun or of the two stars of the Little Dipper that are farthest from the pole. It has been stated that the navigators of those days could compute their longitude from the occultations of Jupiter's moons, but this is ridiculous, since these were first discovered in 1610. The only way for those ancient mariners to compute their longitude was through dead reckoning, using a badly steered course and an estimated speed. Anybody can clearly see that tremendous errors in longitude were under these conditions absolutely unavoidable. Columbus' method of making his landfall was the same that was used by hundreds of thousands of navigators after him, until reliable chronometers were constructed. These men navigated as well as they could, until they arrived at the latitude of their destination, and then they sailed east or west, as the occasion demanded, until they picked up land.

The only nautical instrument that was fairly accurate was the compass, but, of course, even that fell far below the poorest standard of our time. As a curiosity it may here be mentioned that the points of the compass of those days were named differently from our way of doing it. The French and the nations of the Mediterranean still use the ancient way of boxing the compass.

Columbus on his first voyage to America was apparently the first one to notice that the variation of the compass changed to westerly. At the end of the fifteenth century the variation on the west coast of Spain must have been about ten degrees east. It was undoubtedly well known among sailors that the variation changed with the position, since the navigators of those days apparently used to take bearings of the pole star. Columbus' abridged journal says under September 14, "On this day, at the commencement of the night, the needles turned a half point to the north-west, and in the morning they turned somewhat more north-west." Columbus' historian, Herrera, writes: "From this the admiral knew that the needle did not point to the North Star but to another fixed point that is invisible." He adds that this variation had never been observed by anyone up to that time. Another entry, dated September 17, in Las Casas' abbreviated journal reads: "The pilots observed the north point, and found that the needles turned a full point to the west of north. So the mariners were alarmed and dejected, and did not give their reason. But the admiral knew, and ordered that the north should be again observed at dawn. They then found that the needles were true. The cause was that the star makes the movement, and not the needles." The polar distance of Polaris was at that time three and one-half degrees, and the admiral apparently knew that the azimuth of the star would change sufficiently during the night to coincide approximately with magnetic north. Thus Columbus was the first one to note the westerly variation of the compass, and we are told that on his later voyages men were detailed constantly to watch the behavior of the compass.

Nautical almanacs with tables of the declination of the sun, the rough coordinates of a few stars, and tables for finding the latitude by the pole star were published as early as 1457. Latitude, arrived at by observation, is mentioned on four occasions in the abridged journal. These observations were all taken while cruising amongst the islands of the West Indies. It is a curious fact, hard to explain, that the results of these observations, as given in the narrative, are twice as much as they should be. Historians have tried to explain them as errors in transcribing the original notes. This might have been so, if the mistakes in all cases but one were not just the double of the correct latitude. I am of the

opinion that Columbus used the pole star and the astrolabe for these observations, and that he wrote down the sum of the readings on the two scales of the astrolabe, and that these entries were mistaken by Bishop Las Casas for the results of the computations.

There is every reason to believe that Columbus took frequent observations for latitude while at sea, since it is recorded that the discontented crew connived to throw their admiral overboard, "publishing that he had fallen in taking the position of the star with his quadrant or astrolabe." It is more than likely that Polaris was used more frequently than the sun for these observations, because the altitudes of stars could be measured, whenever they were visible, since the instruments mostly used in those days were independent of the visibility of the horizon.

It has been stated that Columbus made a wonderful landfall on his first crossing of the Atlantic. This of course is hardly correct. Columbus did not know where he was going, his voyage was purely one of discovery, and his landfall consequently was neither good nor bad. If he set out for the coast of Japan, he absolutely missed his objective, though he did not know it. He undoubtedly was the best educated and most experienced navigator of his time, and he must be given credit for being one of the most intrepid explorers of all times. It is an undeniable fact that no other geographical discovery has influenced mankind to a degree in any way comparable to the discovery of America.

The following is a compilation of Columbus' dead reckoning on his first crossing of the Atlantic. I have here used the equivalent of 3.18 nautical miles to one of his leagues which seems to be the value most commonly given it. Very little was known about the magnetic data at the end of the fifteenth century. In correcting the assumably magnetic courses I have used the variations compiled by Charles A. Scott in his report to the Superintendent of the U. S. Coast and Geodetic survey, dated April 12, 1881. I have assumed that Columbus' San Salvador is Watling Island of our charts. The distances are here given chronologically, but not day by day, to correspond with each true course.

Magnetic course	Var.	True course	Distances Leagues	Naut. miles
West	3 E	273°	9	28.6
West	2 E	272	49	155.8
West	1 E	271	60	190.8
West	0	270	73	232.1
West	1 W	269	33	104.9
West	3 W	267	20	63.6
West	5 W	265	27	85.9
West	7 W	263	39	124.0
West	8 W	262	130	413.4
WxN	8 W	273	7.5	23.9
West	8 W	262	13	41.3
NW	8 W	307	30	95.4
West	8 W	262	41	130.4
SW	8 W	217	17	54.1
West	8 W	262	16	50.9
SW	8 W	217	15	47.7
West	8 W	262	101	321.2
West	7 W	263	39	124.0
West	6 W	264	47	149.5
West	5 W	265	63	200.3
West	4 W	266	120	381.6
WSW	3 W	245	16.5	52.4
SW	3 W	222	6	19.1
WxN	3 W	278	5	15.9
WSW	2 W	246	20.5	65.2
WSW	1 W	247	86	273.5
West	0	270	24.5	77.9
			1108.0	3523.4

These courses and distances would bring Columbus to Lat. 21° 11′, Long. 79° 55′, and Watling Island would from this position bear N 60° E, distant 351 nautical miles. From this will be seen that Columbus had slightly overestimated his speed. The distance on the loxodromic line from the Canaries to Watling Island is 3083 nautical miles, and the average speed of Columbus' little flotilla was slightly under 4 knots, if the first days, when he was becalmed, are not counted.

THE BENT ARROW RULE

By Lieutenant Commander H. K. Fenn, U. S. Navy

ON PAGES 77 and 85 of the 1924 edition of Robison's *Manual of Radio Telegraphy and Telephony* there appear statements of Fleming's "Right Hand Rule" and "Left Hand Rule" for use as methods of remembering the directional relations that exist between the mutually perpendicular flux, motion of conductor and induced e.m.f.

These rules are handed down from so eminent an authority and their use has extended over such a long time that any criticism of them amounts almost to heresy. In lieu of criticism, therefore, let it be stated that there are those who have absolutely no memory for detail but who can learn only by acquiring a sort of mental picture of what happens. As for these particular rules: in that part of Naval Academy history in which the writer participated, the one that could remember those rules—and get them straight—was promptly crowned King of the May; the rest helped decorate the Pole. Almost everybody used the wrong hand or the wrong fingers!

Without attempting to write a thesis for a doctor's degree, I ask the indulgence of my readers in allowing me to present a mental picture of inductive phenomena which has assisted me in determining the direction of flow of induced current. It is submitted that the idea has the merit of being a fairly close approximation of what actually happens.

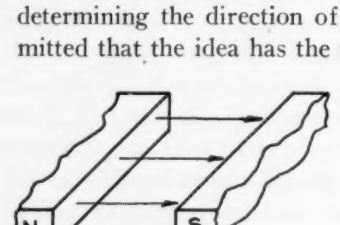


Fig. 1

In the beginning, it must be remembered that the so-called lines of force emerge from the north pole of a magnet into the air gap, and re-enter the magnet at the south pole. See Fig. 1. Also, when a uni-directional current is flowing in a conductor, the direction of flow of this current and the direction of the circular lines of force around the conductor bear the

same mutual relation as exists between the threads of an ordinary right-handed screw and the direction of motion of the screw when turned or "driven." See Fig. 2.

If, then, the lines of force are pictured, as Fig. 1, as a collection of arrows, the actual motion involved, whether it is the conductor or the flux itself that moves, may readily be fitted into the picture as it really exists. If a good stiff conductor moves quickly across a space already occupied by arrows or lines of force it is reasonable to suppose that the latter would be bent around the conductor before being actually cut. Picture them as bent, then, and the bent arrow and the direction of current flow will bear precisely the same relation as indicated in Fig. 2.

FIG. 2

Suppose, for example, that in Fig. 3 a conductor is moved upward, bending the arrows as indicated. The current in the conductor would be indicated as flowing into the paper. If the poles were reversed, the ux arrows would be reversed, and the current would then ow out of the paper.

FIG. 3

It does not matter whether the flux moves or whether the conductor moves, for arrows will be bent in either case, and the direction in which they are curled around the conductor before being cut will in either case determine the direction of flow of the induced current, as indicated in Fig. 2. The inductive effects of intermittent direct currents are likewise apparent if it is remembered that, as the primary current increases, its magnetic field swells up, and the arrow, while maintaining their unity of direction, move laterally outward from the primary conductor bending around the secondary conductor as they hit it. Conversely, the primary field collapses upon

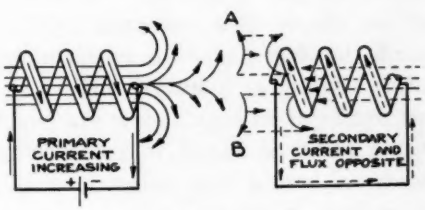


FIG. 4

decrease of primary current, and the arrows are pulled in laterally toward the primary, bending the other way around the secondary conductor. Thus opposite e.m.f.'s are induced in the secondary as the primary current increases and decreases.

As a final test, let us apply this method in confirmation of Lenz's Law. Suppose the primary circuit in Fig. 4 to be suddenly closed so that the primary current is momentarily increasing. The lines of force thus generated are as indicated by the solid arrows. Arrows A and B have a lateral motion and curl around the secondary as indicated. Following the principle shown in Fig. 2, the resulting induced current and its own flux are as indicated by the dotted arrows. Lenz's Law states that when there is relative motion between a conductor and a magnetic field, the current induced in the conductor is such as to oppose the motion. Electrical inertia.

THE SLEEPING GIANT

A WORLD POWER OF THE FUTURE

By Lieutenant Commander W. R. Carter, U. S. Navy

WHEN approaching Rio de Janeiro the coast line at the southward of the entrance to the harbor gives the appearance of a giant lying asleep on his back, head and body made by Gavea, Tijuca, and Corcovado mountain chain and the feet by Sugar Loaf. For many years the "sleeping" giant was quite emblematic. Now, however, the giant is awake, and while still held down, Gulliver-like by pygmy conditions, from these, which are daily recognized as needing reform, he will struggle and free himself.

Let us see what the giant has. To begin with, the giant is Brazil, a country, in area, greater than the United States of America, and containing already discovered natural resources just as great, with who knows what undiscovered resources in the great unexplored regions. Already the world's greatest coffee and rubber producing country and fast coming to the front in cotton, tobacco, sugar and fruits, in agriculture alone Brazil has the proper soil and climate to lead the world.

Its timber resources are the greatest of any country and only await transportation facilities to be exploited to the amazement of the civilized world. Briefly, there are such woods as the massaranduba, the enduring qualitites of which make it almost imperishable for railroad ties. The beautiful jacarandá (palli-sander), mahogany, and ebony, are woods used in furniture and cabinet making. The so-called cedar of Brazil is found extensively throughout the vast Amazon region, and is used in cabinet work and internal fittings of houses. The peroba, a single trunk of which often weighs over twenty-five tons, and is frequently eighteen feet in diameter, is very durable and may be used in boat making, pier building, and structures exposed to wind and weather. In Paraná, are found hundreds of millions of the araucarias, which wood is more than 20 per cent stronger than pine and can be

used in the same manner as pine. There are also several woods in tremendous quantities, which are suitable for paper pulp. Besides those already mentioned, there are various other woods suitable for many purposes, and no doubt still others, undiscovered.

Incidentally it might be mentioned that the loofa, so much used in our navy feed tanks, is found in many parts of Brazil. In São Paulo it is raised for hat making. It is an edible fruit in its early stages. The bambonassa (Panama hat palm) grows wild in Brazil. Some dozen or more trees, producing a red dye, including three kinds of dragon's blood red, grow in Brazil; also two anils, with fine blue colors, and the indigo plant itself. Certain of the fuchsias give a black, and some of the bromeliaceas a brilliant yellow. Gum arabic is obtained, and resins are produced. The vanilla plant is found nearly all over Brazil and cinnamon grows readily in Pará and Maranhão. It may be furthermore asserted that there are many plants producing essential oils and extracts that will repay a hundredfold, when cultivated in a scientific manner. Such agronomical studies are now in progress.

In the pastoral industry, also, Brazil needs only proper transportation facilities to become one of the world's leaders. There are vast expanses of pasturage available for cattle raising, and a large and growing business is already developing. This will, of course, mean tremendous hide and leather business. In South and Central Brazil, there are vast districts well suited to sheep raising, comparing favorably with those of Argentina and Australia. Goats may be easily raised anywhere, in Brazil. Swine flourish and already the state of Rio Grande do Sul has nineteen lard factories, supplied with over twelve thousand tons of fat. Horse raising is progressing and considerable scientific study of this industry has resulted in the improvement of a national race of horses derived from the Arab. The Brazilian Cavalry is already mounted on national equines. Poultry raising is a branch of farming which will be most lucrative. Premiums for the introduction of animals for breeding purposes are now being paid by the Government Agricultural Department.

As in most tropical countries, fish is a favorite article of food. The greatest market is the capital and the supply is exceeded by the demand. Fresh water fish in the Amazon country are very numerous and take the place of meat. Agassiz stated not many years ago that there were more varieties of fish in the Amazon

alone, than in the Atlantic Ocean. For many years the sleeping giant did nothing to protect the fish, but now he has awakened to that necessity and much study and work has been done to protect and improve the fishing industry. Incidentally in passing, it may be of interest to seamen to mention that the shark and dog-toothed baracuda are not the only fish to be feared by a man in the water. The fresh water river fish called the piranha, although averaging only a foot in length and two or three pounds in weight, is a terribly dangerous customer. A school of these have been known to kill and completely devour a large steer attempting to cross the river. I saw a large leg bone of a steer, covered by perhaps ten or twelve pounds of raw meat, thrown into the Paraguay River from a gunboat. It was assailed by dozens of these vicious fish rising from all directions and before it could sink out of sight it was picked as white as a soup bone. However, unless they are very hungry due to poor feeding conditions, it is mainly red meat and blood which makes them vicious, and a man with his clothes on can often swim unmolested across a small river. Off the coast of Bahia there is a small whale fishing industry. The whale is a roqual ranging from thirty to seventy feet in length and is harpooned and killed in much the same manner as elsewhere from boats which put off in the morning and return at night, but, after it is killed, one of the boat crew must dive under it and pass a rope around its mouth to keep the latter closed; otherwise the whale would fill with water and sink. In Pará there is a small fish glue industry. The cat fish is the one which is mostly used for this purpose.

Diamonds of fine quality and semi-precious stones are found in commercially paying quantities in the states of Minas Geraes and Goyaz, yet prospecting has hardly well begun. There are also places where quartz crystal can be picked up and carried off for the asking. Much of this is large and of fine quality, and as our radio experts can testify, this material has come into extensive use, and, no doubt, the output will soon be controlled and regulated in such a manner as to increase the monetary wealth of the giant and make the price of radio quartz higher.

Coal of two kinds is mined in Brazil and while neither is a first class steaming coal, owing to the high volatility, high ash content and low carbon content, it nevertheless is being more extensively used every day, and when used on a proper type of grate (this

has been already designed and experiments successfully made), cleaned or briquetted, it gives about normal results. This will furnish opportunities for commercial endeavors, and who knows when a field of high quality coal will be discovered? Petroleum is found in the states of São Paulo and Parahyba, in the form of shale and low grade asphalt, and the surveys for better oil fields are now underway and may any day result in an oil boom that will put Signal Hill among the "has beens."

Manganese deposits of tremendous value only await proper transportation facilities to make the metal an export to all parts of the world. Remember the ill-fated *Cyclops* was loaded with Brazilian manganese ore when she sailed from Rio to—the Port of Missing Ships. A North American steel corporation has the controlling interest of the largest and richest manganese deposit known in the world, about three hundred twenty-five miles from Rio.

The giant has already discovered most of the usual minerals in greater or less quantities and it can be asserted that somewhere within his broad territories he will in the future find them in sufficient quantities to make him independent of supply from other countries, if he should then find it necessary to stand by himself. So generous was nature in the wealth of minerals that one large state takes its name, Minas Geraes (general mines), from its mines.

Brazil got away to a poor start in the matter of people, as the mixture of black and Indian blood with the early white Portuguese did not tend to improve the people. However, this is better now and Brazil, with a population nearly as great as that of France, is a nation of many races just as our own great nation is. Immigration is encouraged but at the same time regulated, and the population resulting from it is good and new settlements and colonies are leading toward greater and greater exploitation and commercial progress. Since the restriction of immigration by the United States the immigration to Brazil from Germany, Italy, Turkey, and Japan has increased tremendously and some of the states of Brazil by their immigration rules and regulations have profited greatly by it. The effect of the new blood began to be felt almost at once. Among the old Brazilian families there are many patriotic, earnest, far-seeing men and women who have worked and are working for the best interests

of the giant, in the improvement of sanitation and health, cleaning of politics, broadening of industrial activities, and teaching of national patriotism. Brazil is, in brief, undergoing much the same sort of evolution which our own great country did, and, like it, has to deal with the grafter, the bad politician, the foreign fortune hunters, the state disputes, and all the other evils that beset a young republic. The greatest progress has been made in the improvement of sanitation and health. No longer is the dreaded yellow jack feared by seamen. It is practically stamped out. Likewise malaria and other river fevers have been so fought and studied that the danger therefrom has been largely eliminated.

The outdoor sports are becoming more popular each day and already soccer, rowing, and swimming have produced athletes in these events who will compare well with the world's best. True, there are thousands too poor in pocket or health to take any interest in sports; and still others whose toil and drudgery tie them too closely to the grindstone to take interest, but, as said before, the giant is awake and this will all be improved. There are still many laborious and obsolete customs and ways of doing things which are very slow in being overcome, but they will be, nevertheless. The need for schools is recognized, and progress along this line is being made daily and will be even greater as the need becomes more generally felt.

Transportation and communication leave much to be desired. In some parts of Brazil our "covered wagon" method would still be travel de luxe, but when the vast unexplored areas of virgin territory are realized this is not surprising. A Presbyterian missionary, Dr. Robert Daffin of Florida, who has been in Brazil upward of twenty years, told me that he thought he had traveled over fifty thousand miles on mule-back, over trails that permitted of no other method, but that much of this travel was through the finest country of which he had ever heard. Branch lines are shooting off from the main railroad lines, rivers are being bridged, and improved equipment is being obtained. A large bridge over the Parana River is nearing completion, which will when completed bring the great naturally rich state of Matto Grosso into closer contact with the world. Already scattered through that state are men of vision who are sowing the seeds of future greatness for the state. They comprise not only Brazilian born but many foreign born as well, including German, Italian, Turkish, English, and

American. In the little town of Campo Grande, six hundred miles inland on the narrow gauge, wood-burning railroad which pitifully links that part of the country with the more advanced part, I came across a young Scotchman who served in the grand fleet of England and who, realizing the future possibilities, was putting his Scotch keenness into a cattle ranch. He predicted that Campo Grande with the coming of better transportation conditions would cease to be a cow town and grow to a great city, the "Chicago of Brazil." And so it will be with the coming of railway transportation to other naturally rich sections of the giant's territories. Any day the J. J. Hills and Harrimans of Brazil may begin to hit their pace. It is not the lack of vision that has held back railroad development. It is the solution of the financing problems which have given and are giving trouble. Many of these difficulties have been overcome already, and the law making bodies are hard at work now on laws and regulations which will make for easier solutions. A commission of the ablest men of the United States on the question of roads has just visited and inspected many parts of Brazil in order to make recommendation for automobile roads. Their recommendations are sure to be based on far-sighted practical reasons; so, in the future when it becomes too crowded for the tin-can tourist and the automobile bandit in the United States, there will be "new worlds to conquer" down where he can pick his coffee off the trees.

Water transportation has been the principal means of communication for years. The coast line of Brazil is nearly as long as that of the United States and the products of the country at one end as different from those at the other, as those of New England are from those of Florida. The various United States and European lines connect the sea ports from Pará (Belem) at the mouth of the Amazon, to Rio Grande do Sul, with more or less regular arrivals and departures. In addition, there are Brazilian lines connecting not only the sea coast ports but the inland river ports as well, which are flourishing and carrying greater and greater tonnage each year. In fact, during the past year the demand for shipping space exceeded the facilities of two of the Brazilian companies, one of them being the largest Brazilian steamship company. Whenever the expansion of the interior warrants it the inland waterways of Brazil may be so developed as to exceed the Mississippi and Ohio river systems in their palmiest days. The

rivers form a wonderful network of waterways not only in the North with the Amazon and all its innumerable tributaries, but in the South as well, where the Paraguay and Parana and their tributaries furnish a waterway system extending over sixteen degrees of latitude and twelve degrees of longitude. So far, however, river navigation has been more or less haphazard with little or no charting, beacons or aids to navigation such as we ordinarily consider proper. It may be of interest to North Americans to note that the seasonal rise and fall of the Amazon at Manaos, which is about one thousand miles up the river and the highest point which can be reached by ocean going steamers, is often as much as fifty feet. This makes docking a little unusual, but the problem is solved by the use of floating docks with hinged (ferry-boat style) bridges to the shore. The tidal rise and fall of water in the sea coast ports is normal for the latitudes and no maritime difficulties are experienced from this. The sea coast has many splendid natural harbors, some of which have no port or railway. Some of these, little known to the maritime world, are of such area and depth that they would harbor the whole United States Navy. Others not so good naturally will permit of improvement to meet any necessary normal shipping requirements. Today these natural harbors are well known to the Brazilian Navy and their strategic and commercial future is being studied by the officers of the navy. When one considers the rapidity of the development of Japan, after it really awakened, it is not too sweeping a statement to predict that another fifty years will see these natural and artificial harbors of the giant teeming with his and the world's merchant ships and guarded by a formidable fleet of war-gray ships which bear the emblazonment, *Tudo pelo patria,* of the Brazilian Navy.

NAVAL POSTURE

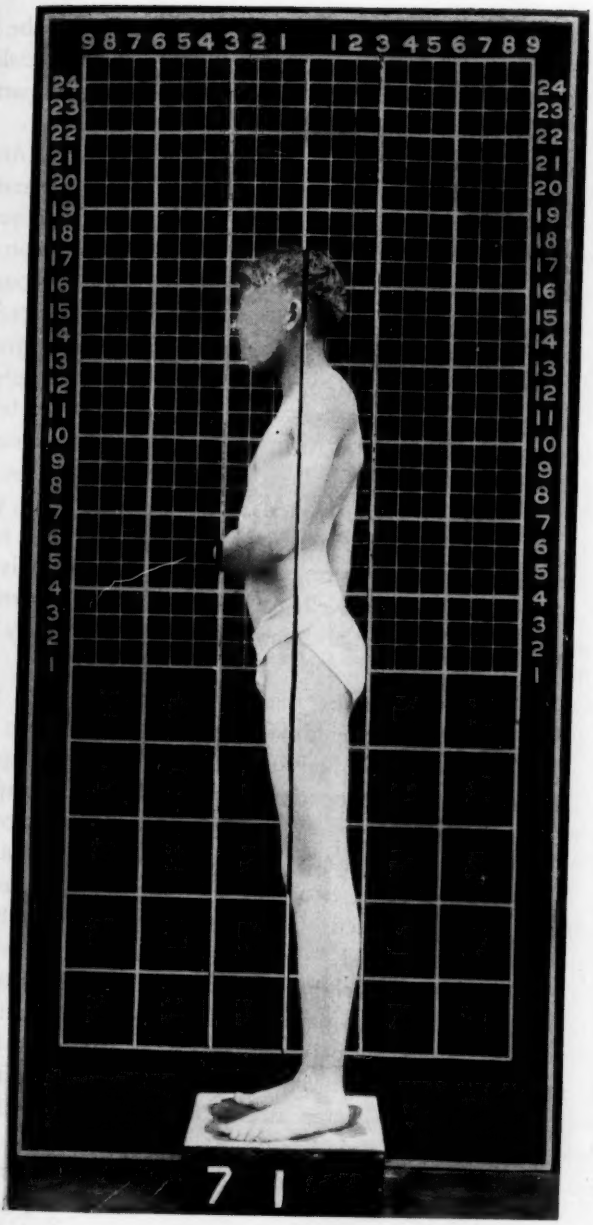
By Walter Aamold, Instructor in Physical Training,
U. S. Naval Academy

A SURGEON rather clever with the pen stated that tight-rope walkers were, by the nature of their work, gifted with almost ideal postures. In return he received a photograph from three hunch-backs who stated that they had been tight-rope walkers from childhood up, in fact two of them asserted that their bent condition had resulted from falls off the wire.

In almost every case the man with a bent posture is advised to exercise. The prescribing of "exercise" in a haphazard way leans toward deformity of posture rather than to the corrections anticipated. Some few skilled gymnasts are sadly twisted out of shape by their pet evolutions. The slogan "Exercise and grow straight!" deserves mild qualification.

The average doctor also is to be checked up on the problem of posture. The established course in medicine does not provide for as much as one hour of instruction in constructive posture. The effects of faulty posture, however, are constantly making work for the surgeon.

Turning to the formal military posture a conflict looms between Old Dame Nature and Army Regulations. The keynote of military posture is tenseness of muscles. An orderly could brace up so rigidly that his lips would be stretched white above his teeth and not a word of disapproval would be heard. Some few soldiers have "braced" their way into the sunlit air of Colorado. Due to the immobility of the upper chest their lungs at this point lose their elasticity, become atrophied—and then when lowered vitality comes along, a horde of germs move in and the soldier moves out. A man improperly aligned jumps a trench and is apt to be carried back on a stretcher with hernia. This, and much more is quite within the limits of formal military posture. Where is the father of this brace—on what principle has it been designed? It would seem that this particular posture originated in the desire to fit the



Able to pass the usual military inspection in uniform. Unsatisfactory in Naval Posture due to rounded shoulders and sway back

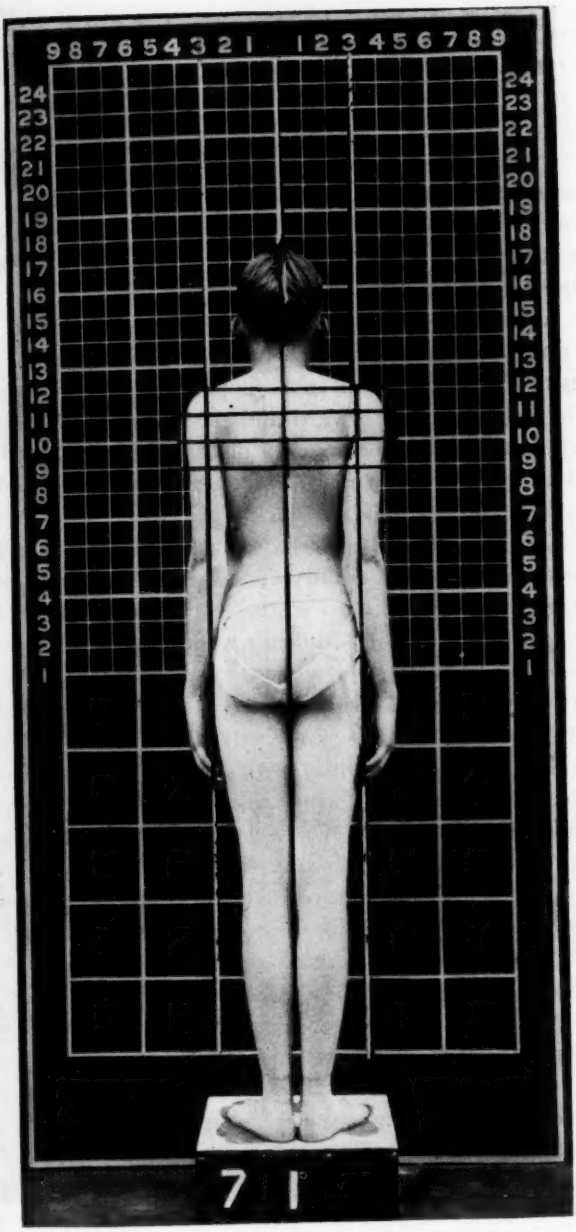
man to his uniform—perhaps the original uniform of the Death Head Hussars. Stated in naval terms, this posture makes no attempt to fit keel and ship together—but does stress in particular the placement of the figurehead!

Apart from this is the naval posture. At the Naval Academy a number of "postures" have been taken apart for examination and study, a modern system of posture has been installed and midshipmen are now being given tests against a posture-graph.

Whereas the average posture expert is but a "few hours old" on constructive posture, the Navy was fortunate in possessing the friendship of Dr. Harvey Kellogg, who for nearly fifty years has been an international authority on the subject. This noted surgeon admitted that he had spent nearly thirty years of trial and error before reaching a true form of posture. With some slight modifications this posture has been adopted for naval use. Captain (M.C.) J. A. Murphy, United States Navy, in 1911, perhaps was the first to investigate posture from a naval point of view. The true foundation of posture *as related to good health* is located in the pelvic region. Dr. Kellogg has worked out a method for measuring the pelvic angle and degrees of error definitely may be determined.

Avoiding technical details, the pelvic bones form a pedestal upon which the spine depends for its upright position. Since gravity pulls through the body-mass attached to the spine, the pelvic bones must first properly be placed before the spine can assume its natural balance. When the pelvic bones are out of place the spine compromises with gravity and an "unhealthy" curve is formed. Rather, two curves are formed, for in balance all weight must be equalized. These curves most generally appear as rounded shoulders and "sway-back." Since gravity is constantly tugging at the upright figure, man in general allows his hips to ride forward carrying the body into a bow from heels to shoulders. With this the pelvic bones dip in front and the spine bends in at the small of the back. The bend in the spine comes almost midway in that barren stretch of bone that reaches from the lower ribs to the pelvic anchorage.

"Sway-back" permits the inner man to get somewhat out of line. It aids the transverse colon in its desire to sag amidships, which twists and partly closes it at each end. By coloring the food of a man sorely afflicted in this way, traces of over thirty meals



Posture, left to right, satisfactory. Deep arch of spine quite apparent in posture-graph

were found in his unfortunate colon. That he had ulcers was no surprise. Many other afflictions appear, such as rupture, added strain on an already hard working heart, and so on along a great circle of errors. Bend in the keel of a ship and the masts fall, the captain is disturbed, even the galley goes adrift.

A correction for "sway-back" is to carry the weight back until it is centered in the middle foot rather than on the toes. Then the hips should be moderately raised in front so as to permit not more than a slight natural curve at the small of the back. This is best executed against a wall or door edge.

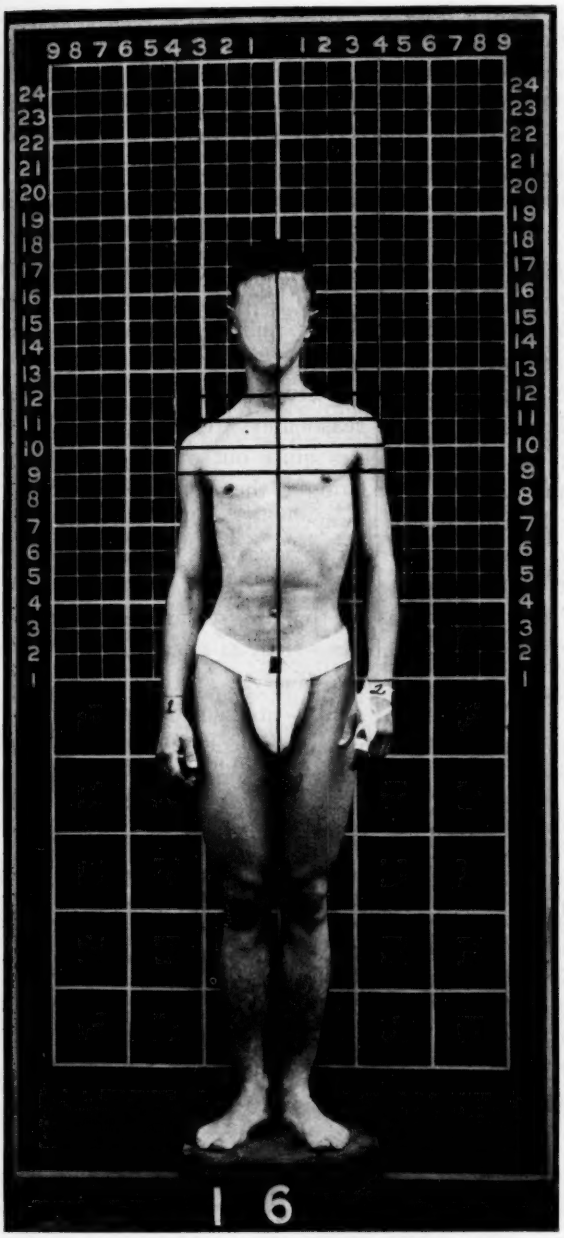
The head nods—almost every one's head does. Dr. Kellogg sends out word from his food factories that "half the world is half asleep." Nature will not support unbalanced weight—so, with the head carried forward and the upper spine bent with it, somewhere there must be found a place to build a curve for compensation. The strain runs down the spine past the ribs to the already curved small of the back. And so, the spine is again pulled in until it catches and balances the head. A rounded upper back means an equal inner curve lower down. A head bent to the left suggests a spine carried to the left lower down. One curve brings on another and it is difficult to designate the first curve of error—both are wrong!

Bowed legs are frequently found with rounded back. This suggests weak bone structure in early life. There are, of course, many other forms of acquired errors and perhaps an equal number of congenital faults. Errors caused by faulty bones are to be distinguished from failure of muscle support, and permanent conditions from those recently acquired.

A simple manual of posture that safely may be followed by a company officer in bracing-up a group of men is as follows:

Prefix commands: *In order to assume a position of attention*—place the heels together, toes at an angle of forty-five degrees, legs straight, knees together, hips carried back until weight is balanced in the arch of the feet, hips raised in front, spine balanced evenly, abdomen in, chest raised, shoulders back, squared, but not tensed, arms hanging naturally, elbows in, thumbs on the seam of trousers, chin in, head back and eyes straight to the front.

A word of caution should be added so that it is understood that the body is not to be held in a rigid condition but rather straightened and then balanced. A man properly braced in this way will



Example of lateral curves. Head and hips carried to right. Note apparent length of right arm as shown by posture-graph

have only a slight curve in his spine and when placed near a wall will be seen to be quite parallel to the wall. If braced up by the usual method he will be arched and leaning and would appear to be ready for a fall on his nose if by any chance the officer in charge should relax his stern vigilance.

It will be noted that the manual of posture as given herein works from the ground up. Young officers selected at random to brace-up a company of men, as a rule do not follow the logical order of balance in applying corrections. Some start out with the command "Brace-up! You, Kelly, pull that pouch in—third man there, raise your left shoulder!"

It came as a surprise in the study of posture to find that many men while relaxed were reasonably straight and when told to "Brace-up" pulled themselves quite out of shape. Others when facing a near object were straight, then when faced about toward an empty horizon, sadly slumped off. *Unless a correct brace is prescribed a man is better off relaxed than while held at attention*

Correct posture, in the end, must become a sense of muscular balance from within, rather than muscular strain applied from observing some outside object—such as gazing upon the company officer and compensating accordingly. To the individual a mirror is a most excellent field of study—at least in the beginning. Lying relaxed upon the deck with spine and neck pressed down, enables the memory to "get the feeling" of a naturally straight spine.

The subject of posture is dangerous in its simplicity. When all has been said—the body has but to learn to balance its weight upon bones which are easily kept in line as against the usual practice of letting muscles carry the weight—as a horse does his head.

A study of many hundreds of recently made posture-graphs is being carried out by Lieutenant (M.C.) G. E. Mott, U. S. Navy. In the near future it is very likely that definite figures on posture angle, normal neck curve, and so forth, will be forthcoming. With this information available, training stations in particular will be able to record definite values in posture.

NAVY SERVICE SCHOOLS

By Commander Oscar Smith, U. S. Navy

IN ORDER to keep the Navy's complement of petty officers approximately filled at all times, it has become necessary for the Navy to make petty officers in certain ratings by special education and concentrated training, instead of "striking" or apprenticeship at the detail or in the office on board ship, to which the candidate aspires. The vast majority of ratings are still filled at sea in the customary manner, but technical ratings, such as machinist's mates, electrician's mates, musicians, boilermakers, blacksmiths, and coppersmiths are required in greater number than the facilities on board ship can supply them. During past years, the Navy has been deficient in these ratings. To correct this deficiency, large quotas of students for the service schools on shore were authorized in 1923 and 1924, to be filled by recruits selected at the training stations upon completion of the eight weeks recruit training, and before their transfer to sea.

As a result of this policy, the Machinist's Mates School, for example, has graduated about thirty-five men every three weeks as qualified for the rating of machinist's mates, second class. These men have gone from the school to assignments at sea after eight weeks recruit training and approximately ten months in the school. In other words, most of the machinist mate material now in the fleet as machinist's mates, second class, or awaiting appointments to that rating, consists of men who have just reported from the school after one year of service, no part of which has been spent at sea. In many ways, this is an unfortunate condition.

Up to about July 1, 1924, the majority of the men in the Machinist's Mates School at the Naval Training Station, Hampton Roads, Virginia, were men who came to the school from sea, and were recommended for instruction at the school by their commanding officers. This method would seem to furnish men of greater general experience, who would make better machinist's mates, than does the method now in use. But this practice has

nearly fallen into disuse and at the present time approximately but 10 per cent of the student body of the Machinist's Mates School has had previous sea experience.

Since it is conceded that our present policy is unfortunate in many respects, it seems appropriate that the officers charged with the duty of training petty officers, in and for the fleet, should make a careful study of conditions, analyze causes, difficulties, and results obtained, and arrive at a clear, definite decision as to what method should be established in order that the greatest benefit should accrue to the Navy by their training. The writer sets forth herein some phases of the situation as they have been presented to him, during his previous tour of sea duty in the fleet, and during his present duty as officer in charge of the service schools at Hampton Roads. He also accompanies the discussion with conclusions and recommendations which appear appropriate from his point of view.

He recognizes the fact that the demand for men, trained and untrained, from certain vessels and fleets, precludes the possibility of establishing a stable permanent policy, as any policy is dependent upon the varying conditions in the fleet. For example, if under the present plan an excess number of graduates are furnished the fleet from any one school, so that all vacancies in the rating supplied by this school are filled, then a different situation is created from that which made the present policy a necessity; and rather than continue as at present, it may be preferable to change the policy in order to meet the changed conditions. But this situation can be met by a flexible compromise.

Service Schools at Hampton Roads, Virginia.—In order that the reader may thoroughly understand the situation at the service schools with particular reference to those at the Training Station, Hampton Roads, Virginia, the following explanation of the courses of instruction is furnished, before the discussion is started.

At this station all service schools are operated as a part of the Training Station, under the commanding officer of the Training Station. The schools are grouped in a department entirely separate from the department of recruit training. An officer, either lieutenant-commander or commander, is detailed by the commanding officer as officer in charge of service schools. The schools themselves are divided into three divisions; first, mechanical division consisting of the Machinist's Mates School and the Artificers'

School, with the classes (1) boilermakers, (2) blacksmiths, (3) coppersmiths; second, the electrical division, consisting of the Electrical School and the Radio School; third, the General Division, consisting of the Yeoman School, Musicians' School, Recruiters' School, and Naval Academy Preparatory Class. Each of these divisions is in charge of a lieutenant or lieutenant (jg), with such assistant officers and warrant officers as are available. Special officers are assigned to duty with the Recruiters' School and Naval Academy Preparatory Class.

The curriculum of each of the schools is drawn up to contain as much practical instruction as can be given, with the theoretical instruction reduced to the minimum that is consistent with the requirements of the petty officer, in the rating for which he is being educated. In the Machinist's Mates School, the first three weeks of the course are spent in a review of arithmetic, covering only the handling of fractions and decimals which is required in the reading of blueprints, in the setting of gauges, and in ordinary work on board ship. The next two weeks are spent in teaching the student the elements of blueprint reading. No attempt is made to qualify the student as a competent draftsman, but he is taught how to read and to make simple drawings such as he must use in his regular work.

The next twenty-one weeks are all practical. The students during this time learn how to actually operate hand and machine tools, and are given an insight into what can be done by the tinsmith, coppersmith, and blacksmith, so that they may be able to take advantage of these allied trades, when they are more competent to do a job than is the machinist. The last three weeks of these twenty-one are spent in making actual repairs to the machinery and equipment of the Machinist's Mates School. As this equipment consists of machine tools of every kind found on board ships, and of pumps, engines, and other machinery used on board ship, this period is of greatest value to the student. It enables him to use the knowledge he has gained in practical work, similar to the repair work which will be required of him at sea.

The following nine weeks are devoted to instruction and practical work with the various engineering appliances, ice machines, evaporating plant, condensers, pumps, and so forth, which are found in the engineering department on board ship; so that the student, when he reports on board, will quickly be able to identify

the various machines and auxiliaries, and will have an understanding of their utility and operation. The final two weeks of the course consist of an examination which weeds out the fit from the unfit, and enables the officer in charge of the school to make definite recommendations, as to which men have successfully learned the practical and theoretical knowledge which has been taught them. Thus he is enabled to select those who are actually competent to hold the rating of machinist's mate, second class, as far as their technical requirements are concerned, when they leave the school. These men are graduated.

The Electrical School has a twenty-four weeks course of general electricity. During this time, one week is spent on each of the following subjects: magnetism, units and resistance, circuit calculations, generators, electro-magnetism, field construction, armature winding, motors, control of motors, maintenance of motors, batteries, alternating current, applied alternating current and electric drive, operation of generators and switchboards, instruments, motor boat and battery ignition, light and power, searchlights and signal devices, interior communication, ship-control, and fire-control. During each day the students have practical work in the subject for that week. For example, in armature winding the students actually wind armatures; in the motor control week, they make the actual connections to rheostats for control of motors; in the battery week, they repair, assemble, and charge batteries. In every week they carry on practical work to as great an extent as possible.

The last eight weeks of the Electrical School course are devoted to the gyro-compass and final examinations. In every way, throughout the entire course, the effort is made to teach the student what he will have to do practically on board ship, and to avoid merely furnishing him with theoretical knowledge which he must adapt to practical use at sea.

The Musicians' School has a course of 150 lessons on each instrument, so arranged that the average student by close application and average musical ability can successfully complete one lesson each school day. When a man is graduated from the Musicians' School he has mastered the elementary technique of his instrument. He has played with his instrument in the assembled school band, and he has been taught sufficient music to enable him, when he gets on board ship, to advance and improve himself continu-

ously in his regular work in the band at sea. Further, such men as have talent for orchestra instruments also are taught to play the violin, cello, piano, and so forth, so that the fleet is given men from which they can build and maintain orchestras.

Bearing in mind that the above examples are typical of the courses of instruction now maintained by the Bureau of Navigation in service schools, it is plain to any one who carefully studies the subject that the often repeated charge, which is made by sea-going officers, that service school graduates should receive more practical instruction and less theory, cannot be substantiated in fact. It is believed that this charge is frequently based upon the inability of a service school graduate to immediately perform some practical work on board ship, which is a common and a customary job at sea, but which is not exactly similar to any of the work carried on in the school. To expect a graduate to go ahead with every piece of work is a false expectation, which is not realized by these schools nor by any other school; and until the service at large understands that the service schools graduate men who have received excellent educations in their trade, but who still require practical work at sea to fit them for their ratings, all graduates will be handicapped on their first duty by this misconception on the part of the officers to whom they report.

Recruits as Students in Service Schools.—At present recruits are assigned service schools according to the following procedure: All recruits who report at the Training Station are given the O'Rourke General Classification Test. During their period of detention in the receiving unit the existence and nature of the service schools at this station are explained to them. Once again while they are in training, the officer in charge of service schools appears before the recruits and describes to them the nature of the schools, and how ratings are obtained in the Navy, both through school education, or through practical education on board ship. Such recruits as desire to enter any school submit their names to the officer in charge, and those who have made a score of 50 per cent or better, on the general classification test, are referred to the schools which they have requested, and are there given the aptitude test, to determine their fitness for the trade they have selected. The officer in charge of the school, using the results of both of these tests as a guide, then selects those men whom he considers best qualified for the school in all respects.

The number of students selected is restricted to a certain quota established by the Bureau of Navigation.

If it should develop in any one week that more applicants appear whom he considers good material for the school, than is allowed by the quota, he will select such additional applicants as he considers proper. The succeeding week or weeks he will restrict his selection so that his average of selections for the quarter does not exceed the quota authorized by the Bureau.

The advantages of this system are, that men who enter the service with a talent for machine work, electrical work, radio, and so forth, immediately apply themselves to a course of instruction, which gives them a thorough foundation for their development into the petty officer ratings as soon as they go to sea. The disadvantage of this method is, that these men go to sea and in many cases receive their appointments without the proper amount of sea training. In other words, although technically qualified as machinist's mates, electrician's mates, and so forth, still they are in no way qualified, and it is impossible that they can be qualified, for the military duties of the ratings. Further, many of the men selected are capable, good workers, and well qualified technically, but they are too young to properly administer the military duties of their rating over the older men whom they find on board ship. This disadvantage is a serious one and well worthy of consideration. In view of the double requirement of any petty officer, that he must be technically qualified and also militarily qualified, for his rating, it is very questionable if the present practice should be continued, particularly for the rating of second class petty officers such as is usually handed to graduates of the Machinist's Mates and Artificers' Schools shortly after they go to sea.

Candidates in Service Schools Who Come from Sea.—The Bureau of Navigation *Manual* allows the commanding officers of ships to recommend certain qualified men for transfer to the various service schools. The purpose of the privilege is to furnish a means by which a man who has proven his worth on board ship, but who requests special education which cannot be efficiently supplied at sea, may be transferred to a school and there be taught sufficient to enable him to qualify for the technical duty of a rating, for which he has shown his fitness, during his service at sea. Were the commanding officers of ships to use this privilege in the manner intended, there would be no question of sending recruits

to service schools. But, unfortunately, on account of the crying need on board ship for good men, such men are not transferred to the schools, but on the contrary are rated on board ship in such ratings as coxswain, boatswain's mate, gunner's mate, torpedoman, and so forth, where the necessary technical education can be supplied at sea without loss of the services of the man himself. Instead of these excellent men coming to the schools from sea, we find the majority of men who come from ships to be only of average ability. Frankly, we cannot expect anything else. The commanding officers are responsible for the efficiency of their ships. They must train petty officers in many ratings. The accomplishments of their ships are dependent upon the ability of the enlisted men on board. Therefore, it is not reasonable to expect them to select their most capable men for transfer to a shore station for trade school education as machinist's mates, electricians, and so forth, when they need such men on board for present urgent work.

As a result, the men who come from sea are generally of mediocre ability, although they have good points which merit recognition. There are frequent cases of men who are serving on their second enlistment as firemen or seamen, who lack perseverance and ambition, but who are faithful and valuable in their nonrated positions. In hopes of helping such a man, his division officer will recommend him for training at a service school, not because he considers him exceptionally well qualified for the rating, but because of a desire to help him along, even though the man will not help himself.

Then occasionally men who desire to get away from a ship, will request assignment to a trade school, and their requests will be approved without regard for their lack of fitness for the detail requested. Such men instead of taking advantage of the golden opportunity thus offered, often make no effort to learn a trade, but are content to be sent to sea again on some other ship. In order to correct this defect in the system, all men who come to a service school are returned to the ship from which they came, upon graduation, or when transferred from the school for cause.

Unfortunately, in most cases, by the time the man has proven his fitness or unfitness and is returned to the ship, the officers responsible for his transfer to the school have been either detached from the ship or from the duty, so they do not know of his return.

Therefore, the individual officer does not realize that his consent to the transfer of such a man to the service schools has been a loss to the government, if the man proves himself unfit; and what is worse, a direct blow at the efficiency of the Navy's training of men for the petty officer ratings.

Therefore, although theoretically this method of obtaining students in the schools for training petty officers in the technical ratings is the best method, still, practically, it has not been successful in the past and probably will not be successful in the future.

A Compromise Proposal.—It has been suggested that instead of attempting to give a complete trade education to the recruits in the service schools on shore, the present practice of transferring large quotas, even larger than at present, if practicable, from the recruit units be continued, but that they be retained in the service schools for a comparatively short time, eight to fifteen weeks at the most; whereas at present it requires thirty-eight weeks to complete the Machinist's Mates School course, and thirty-two weeks to complete the Electrical School course. During this time in the school, these men would be taught the rudiments of their trade so that they could then report on board ship, and the officers afloat could select from these graduates the best men for practical training, and thus rate them petty officers as the result of their work at sea. The benefit of this method would be that these men would qualify technically and militarily at the same time, and thus this deficiency of the present system would be corrected.

What are the defects of this plan? The first objection appears to be the fact that the only reason for the existence of the service schools is the inability of the fleet to train men for the ratings which are supplied from these schools. If the complement of machinist's mates had been kept filled in the fleet, there never would have been any question of starting a Machinist's Mates School. If the complement of the electricians, radiomen, blacksmiths, and so forth, had been filled by ratings in the fleet, there would never have been a question of starting an Electrical School, Radio School, Artificers' School, and so forth, at any shore station. Therefore, it is extremely doubtful if furnishing the rudiments of the technical knowledge required of men in these ratings, will give sufficient ground work for the men to progress at sea, fast enough to keep the complements filled.

It should be noted that service schools have been required only in comparatively few ratings. These are specialties which require training and education that cannot come to the enlisted man in the regular course of his duties. No service school is required for engineman, boatswain's mate, coxswain, and the like ratings, because the knowledge of the work required in these ratings is accessible and easily gained on board ship. In contrast, the electrician's mate, machinist's mate, and musician must know considerable about their trade in the way of general and special information and theoretical knowledge that can only be taught at schools.

Another objection to this plan is the fact that on board the smaller classes of vessels, such as cruisers, destroyers, gunboats, and so forth, very often, when a machinist's mate is requested to fill the complement, due to the vacancies in that rating in the Navy as a whole, a qualified machinist's mate cannot be supplied, so a service school graduate is sent instead of a rated man. For such a billet an elementary graduate would not suffice. These ships, with their small complements, are unable to train men as "strikers" for every position, and would be unable to give the additional training to the graduate from a service school, who was sent to the ship with only a rudimentary knowledge of his trade. They require a thoroughly competent graduate.

A third objection to this plan is the fact that whereas at present every man who enlists gets an equal opportunity to attend such service school as he desires, it would be impossible to transfer the graduates after their elementary training so that they would have equal opportunities for making their ratings. Some ships would probably be able to run regular schools of instruction, while other ships, which at the time might have no need for petty officers in these ratings, would utilize the school graduates for general work about the ship, and they would eventually fleet up in other ratings with a complete loss of their time in the school, and great dissatisfaction among the men concerned.

Conclusions and Recommendations.—Mature consideration of the service needs, and the various methods of supplying petty officers, has convinced the writer that a better grade of technically qualified petty officers competent not only for their trade duties, but also for the military duties of their ratings, will be furnished by maintaining service schools which give a complete course of in-

struction with as much practical work as possible; the students in most cases to be drawn from recruits. It must be understood that this technical education must be supplemented by additional practical work for a period of time at sea, the length of which period is dependent entirely upon the capabilities of the individual man. During this probationary period at sea, the service school graduate will learn the practical application of his trade in every-day work and will also learn the military duties of his rating, and, if competent, he will learn how to handle men, and will develop his ability as a leader of men.

The practice which has been followed in the past by the Bureau of Navigation of completely closing schools once the complements in the Navy as a whole, in the ratings supplied by that school, are filled, should be discontinued. The school should be continued, even if the quota is reduced to one man per week, and the instructors to one chief petty officer. The maintenance of the school at so little personnel cost to the Bureau provides a continuity of policy that enables the Bureau at any time to expand the school, without a great loss of time and effort. Where considerable equipment is required in a school, for example, in the Electrical, Machinist's Mates, and Artificers' Schools, a small complement of students will keep all the equipment intact, and in excellent condition, whereas, if such a school were discontinued entirely, there would be enormous wastage, loss, and frittering away of valuable machinery and equipment which could not be replaced when expansion of the school was required, without a great expense to the Navy.

Further, it should be kept in mind that a condition in the fleet which requires the starting of a school to fill a certain rating one year, is only appeased by the supply of graduates from the school to fill the vacancies in the fleet. The condition still exists, and in the course of time, if the school is completely closed, vacancies will begin to appear in that rating, and the school will have to start its instruction again.

Therefore, it is recommended that when the peace-time requirements of the Navy demand the establishment of a school for the training of petty officers, once such school is started and equipped, it shall continue in operation, but that its quota of students will be reduced to accord with the demands of the service. In order to raise the quality of the graduates of these schools, in

cases where the complement at sea is fully provided in ratings supplied by any school; in addition to reducing the quota for entrance to the school, such school should be authorized to graduate only a certain number of men per month. The result of this action will be that the laggards will be dropped at different periods of the course, and only the best men will reach the graduation period and be sent to sea as qualified for practical instruction for their ratings. This will increase the quality of material available for the rating, without increasing its quantity. Such action will further maintain the continuity of policy in the school. It will enable the school to develop, and improve the instruction, because only high-grade men will be continued in the school, and effort will not be wasted on men of only average or below average ability.

As to the source of supply of students: the schools must continue to draw the major portion of their quotas from the recruits. The present instructions which allow ships and stations to send men, with the Bureau's approval, to service schools should be continued, and, if commanding officers send only qualified men to them for instruction, then the recruit quotas can be cut down or entirely abolished, and the service schools will be on the high plane that was originally intended, with graduates capable of performing all duties of their ratings.

DISCUSSION

Post-Treaty Naval Design

(See page 2125, November, 1925, PROCEEDINGS)

BROCKHOLST LIVINGSTON.—Messrs. Bywater and Prendergast in their article which deals primarily with the projected French 17,500-ton *croiseur de combat* have taken advantage of the opportunity to make several thrusts at the Washington Treaty for the Limitation of Naval Armaments. They make mention of the "intense dislike with which the treaty is regarded by Frenchmen at large." Surely France, with a government similar to ours can not pass through their senate, treaties which are characterized as "ridiculous." The French nation had the privilege to accept or refuse the provisions of the compact. Having legally accepted these limitations of her naval power, it seems out of place now to grumble through the medium of a foreign writer, if indeed, these are the opinions of "Frenchmen at large."

After reciting the account of the war movement of the fictitious French *Indomptable,* the writers state: "To all existing cruisers they (the 17,500-ton cruisers) would stand in the same relationship as the *Dreadnaught* stood to the pre-dreadnaught." In the same, rather let us say, as the modern battle cruiser stood to the old armored cruiser. A revolutionary design in naval architecture is not expected to be met at once. The battle cruiser has been met by battle cruiser and so the phenomenal *croiseur de combat* will be met by its more powerful kin, the 35,000-ton battle cruiser of the fleets of Great Britain, Japan, and the United States. The present writer, in discussing an article by Captain Taussig, advocated, in the PROCEEDINGS for September, 1925, the replacement of our capital ship tonnage in the following manner: "One fleet flagship combining high speed, a few heavy guns, moderate armor and deck space for airplanes; *four battle cruisers for the scouting fleet;* one battle fleet flagship, and three divisions of three ships each representing the present battleship, heavily armored and carrying the largest number of guns at a moderate speed." It is believed that the 35,000-ton vessel armed with 16-inch guns and a speed at least equal to the *Indomptable* type would be the proper weapon with which to combat the smaller vessels, and also as a defense against such larger vessels as may be constructed up to the limits of the treaty as regards total and individual tonnage. There has always been a conflict of opinions in regard to one large or many small vessels but the present trend is to create as large a ship as is permissible under existing treaties. One large vessel is also more economical than two small ones, the total tonnages

being equal. For France, possibly two 17,500-ton vessels would be of more use than one of 35,000 tons, but for the major signatory powers of the Washington agreement the latter are an assurance against anything which a possible enemy might construct. In support of a policy against *Lepanto-Glorious-Indomptable* types, the present writer quotes from the PROCEEDINGS for November, 1925: " . . . . the *Glorious, Furious,* and *Courageous,* brilliant conceptions of a most able officer, but worthless ships for their intended functions when built." (Commander Howard in a discussion, page 2166). Even in our own navy, the writer remembers the plea of a civilian for small, fast, super-cruisers armed with one or two 14-inch guns. The desire was forgotten amid the myriad cries of the opposition, cries which materialized in our battle cruiser hulls, now scrapped.

There is no doubt that the proposed *Indomptable* would be more than a match for a "10,000-tonner" but is not the "10,000-tonner" a match for a destroyer? Type must meet type, but in the planning of a type the most must be put in it. It must be a match for the *most powerful, possible,* enemy vessel of the same type. Italy may, as the writers suggest, use her allotment in building three vessels of 23,333 tons apiece but the other signatory nations must, as a protection against each other, construct battle cruisers of the largest possible size and speed and carrying the heaviest armament and armor practicable. In considering this point the treaty has been unconsciously laid aside but it must always be kept in mind. Italy and France *alone* are permitted to employ the tonnage as considered advisable. The other nations may build only the number of vessels stated. The individual vessel can not exceed 35,000 tons. It may, however, be less than that should any nation be foolish enough to so construct its vessels.

The *Indomptable* type is a dream. So are the future capital ships of other powers. When the former appear we may then, if neccessary, change our plans accordingly. As it is at present the French designs incline to the torpedo-ram-aircraft schools. As such they must be taken "with a grain of salt."

For the sake of argument: If the *Indomptable* is to be such an elusive mass of destruction which no existing opponent could destroy, how can attack have mastered defense and thus cause the placing of the turrests as planned?

Did I not know better, the authors' question as to the person who composed the treaty definition of an aircraft carrier would sound rather like a decided "slam" to the technical personnel of our commission to the conference but, be that as it may, we shall consider their statements further.

It would appear that the three requisites necessary in order that an aircraft carrier may be considered as such were used in phrasing the treaty in order that a distinction might be made between the accepted conception of an aircraft carrier and vessels of the *Furious* (of 1917) type. To be considered as an aircraft carrier within the meaning of the treaty, a vessel must be capable of all *three* functions. Accordingly the *Furious* (of 1917) would not be classed as an aircraft carrier. It will be remembered that all

carriers *then built* (that is in 1921), were classed as experimental and are not included in the tonnage allowed each nation. It might be further remarked that the *Furious* class of vessels were an exception in that, although not classed as capital ships they, nevertheless, carried capital ship armament. In the future the nations may be guided by the rule that any vessel over 10,000 tons is either an aircraft carrier or capital ship. Should a vessel be designed for "the specific and exclusive purpose of carrying aircraft" it will not be armed with a gun larger than 8-inches, but should it carry a larger gun it must then be classed as a capital ship, thus reducing the number of pure capital ships allowed. Nations would not, it is believed, reduce main armament in the interest of carrying aircraft. The present writer believes that the treaty was exceptionally well worded in this respect and that it leaves nothing to one's imagination.

The authors question the clause "sole and exclusive purpose of carrying aircraft," stating it to be "the weakest part of the whole definition." If a vessel is designed to carry aircraft exclusively it is an aircraft carrier. Naturally it has some armament, even the supply ships and tenders have that, but to draw a line between the aircraft carrier and capital ship, the restrictive clause was added that aircraft carriers could not be armed with greater than 8-inch guns. Once that size of gun is exceeded, the vessel is no longer an aircraft carrier but a capital ship. Its "sole and exclusive purpose" is then, not only the carrying of aircraft, but also the carrying of major caliber guns by which it becomes a capital ship.

The nation which has enough faith in the power of the airplane to increase its aircraft carrying capacity at the expense of the big gun is at liberty to do so. This, anyhow, is the personal opinion of the present writer.

In place of the contre-*Indomptable* armed with 14-inch guns, the writer would suggest a fast (35 knots at least) battle cruiser armed with 16-inch guns even if at a sacrifice in armor. Against an *Indomptable* the contre-*Indomptable* would have the advantage in weight of metal but against a post-treaty battleship the 14-inch gun would be of restricted use.

The present writer regrets he has not a complete text of the Washington Treaty at hand but then that comes of travelling and leaving behind one's base of knowledge—his books. Trusting, however, to the facts as given in the article itself, it appears that the authors claim Italy's right to replace the *Leonardo da Vinci only* if France replaces the *France*. If Italy is *then* allowed to undertake replacements, there is nothing in the treaty which restricts her from constructing this new tonnage *immediately*.

It is feared that Great Britain's claim to "the right to commence in 1931-32 seven ships of 20,000 tons in place of the four 35,000-ton capital ships" would not meet with favor in either the United States or Japan. The treaty has now been subjected to many interpretations by many schools of thought but to thus claim exemption from a specific clause would meet with valid rebuke.

France may find the *Indomptable* type necessary to her naval power but these vessels would indeed be "a type (best) suited for operations in the

Mediterranean, Baltic, North Sea, and so forth." For the United States, we desire vessels suited for operations in all waters but *especially* in the *open sea.* Accordingly, the *Indomptable* is not to be feared as a possible revolutionary power.

The Three Craftsmen

(See page 2050, November, 1925, PROCEEDINGS)

Our Vanishing History and Traditions

(See page 15, January, 1926, PROCEEDINGS)

BROCKHOLST LIVINGSTON.—Ensign Eller tells us *why* we should preserve our traditions and history and make these a part of the ingredients which go into the mold from which we produce our officers. Captain Knox, on the other hand, tells us *how* we may preserve the material history; the written words of tradition. Both are noble aids in the solving of the difficult problem of how we shall best educate the future naval officers of the nation.

That Captain Knox's plea to keep together our naval records is a worthy one, it is needless to remark. The fact that they must be retained in a centralized record office is so apparent that his article needs no discussion but one of approval—which it will receive in plenty. Ensign Eller's paper, however, is more revolutionary and consequently is more entitled to expressions of approbation or disapproval according to one's views.

It is especially gratifying to see so young an officer expressing his views in print and expressing them in such terms as Ensign Eller has used. With the spirit he has put into his paper we may indeed look for a time, in the not too distant future, when the sword and the pen of the *littérateur* will be held by the same hand.

There is, indeed, needed such an annual prize for biography as Ensign Eller has mentioned. The Naval Institute is preferably the organization which should have charge of the competition. Its earlier origin and wider field give it advantages over the *Trident.* To create such a fund would appear to be a comparatively easy task. The sum of $3,000 would be ample to provide for all expenses and would assure a set of biographies which would aid a great deal in advancing the study of history and the lives of the great military and naval commanders. Thirty persons should easily be found who would gladly donate $100.00 each. From these should be chosen the judges of the year's essays who would act in consultation with certain members of the staff of the Naval Academy. This is certainly a subject which should be advanced along with Captain Knox's plan for the creation of a fund to aid in preserving the records of former periods in naval history.

Environment, one of the three craftsmen, is made up in part of another ingredient, *Tradition.* Ensign Eller admits there is some traditional environment at the Naval Academy but he asserts there is a great deal of room

for additional surroundings which ring of the past, its heroes, and victories. He suggests naming the companies after "eight of the greatest men any navy has produced." His plan is splendid and most certainly should be carried out. It is the purpose of the Academy to form men of the character of Jones and Porter, men who are superior to the mechanical knowledge of the navigator and engineer, and shipwright.

The flag as the symbol of the nation should be brought into the life of a midshipman as much as possible. Once having learned to know the deep value of this insignia, each man will indeed "resume . . . . marching, sobered and thoughtful, each . . . . feeling a bit bigger, a bit closer to the ideal of the flag."

Would not the *Environment* of the Naval Academy be nearer perfect if tied to the piers were the ships upon whose decks trod the heroes whose names are emblazoned on the walls and the monuments of the Academy? Would it not be better by far to have the *Hartford*, the *Olympia*, and the *Constitution* on duty at Annapolis in place of the *Cumberland* and the *Reina Mercedes*, good ships, we will admit, but holding little of that ethereal glory—*Tradition?* Would not the shades of Farragut, Dewey, Hull, Bainbridge, Stewart, and Preble, appear to those midshipmen who paced the decks of these famous vessels? Would not the heart of any of them thrill as he marched on board these once valiant but now peaceful warriors of the seas?

There is sound sense and there is sentiment in Ensign Eller's paper. Both can be thoughtfully studied and made use of in increasing the distance between our Naval Academy and those "other contestants close behind. . . . . " We must not "win by a narrow margin when (we) might have swung the world to its feet in a wild cheer of praise." We of the Naval Institute can do our share in bringing about at least one of the improvements Ensign Eller has suggested. The creation of a fund for an annual prize for biography should be a reality in the very near future.

Our Vanishing History and Traditions

(See page 15, January, 1926, Proceedings)

Louis F. Middlebrook.—The naval activities of this country during the American Revolution of 1775-1783 are but sparsely recorded, and only a few authentic official references exist, due perhaps to the indifference of historians and the lack of proper analysis of the origins of the historic naval data of that period. A worthy article written by Captain Dudley W. Knox, U. S. Navy (ret.), has recently been published to show the need and wisdom of centralizing the individually owned naval data and manuscript evidence, or allowing it to be centralized by process of reproduction. The article is a very commendable one, and due to receive favorable consideration and action by those whose knowledge of such history exists. The appeal is such a strong one that results should be spontaneous and liberal.

To reinforce this splendid plea and to enable the office of Naval Records to obtain these important documents and manuscripts evidence so sorely

needed to augment the history of the origin of our nation, there would seem to be necessary for consideration and careful thought, firstly, the line of least resistance where the largest percentage of this dormant history lies, and about which naval officers and others certainly must know; and secondly, the possible employment of naval officers, by the occupation of their short time for this purpose. It hardly seems necessary to point out where perhaps seventy-five per cent of the unwritten naval history of the Revolutionary War may be found. It has been waiting, moulding and decaying for some officially authorized historians of this government to review, for about 150 years. Most of us ought to know if we think it over, that during the War for Independence there were admiralty courts set up in nearly every British province or colony in America. Some were known as Prize Courts, and others as Maritime Courts or Admiralty Courts, and whenever a British prize was taken, one of three things happened as a rule, viz.: that price either arrived in some port on the Atlantic Seaboard for libel by a Prize Court, it was burned or sunk, or was recaptured. If it was captured and arrived, the records of that court should now be available, if the place of custody still exists. A reference to the state or colony laws or records of that period will show where they existed and in many cases, will or should, show the names of the court official or officials appointed by the governor to preside over such bodies. Those records should contain, and do contain (in Connecticut) the libel, decree, depositions containing details of the combat or capture, as well as names of vessels, tonnage, guns, number of crew, name of master prizemasters, copies of commissions describing officers on their reverse side, copies of ship's papers, orders, permits, once in a while some correspondence en route—in fact all the data there are, and in many cases the ship's articles and crew lists. This is naval history of the first water and sworn evidence enough for any historian or Record Office to possess either in original or copied form. In most colonies it was by law compulsory to publish the libels and holdings of courts in the newspapers. A review of these newspapers, such as are on file in Philadelphia, (undoubtedly in Congressional Library at Washington), New York, Hartford, Boston, New Haven (Yale University), Salem, and other seaboard localities where newspapers were printed during the war, will form a sufficient authentic nucleus for anyone with intelligence and time enough at their disposal, to gather in at least thirty-five per cent of the unwritten naval history of the Revolution. Any man's estimate of another forty per cent of this history should naturally attract him to the then enemy's records to offset what he is able to discover in this country by the above means. That is by delving into the outcrying bundles of evidence waiting in the Public Records Office of the British Government in London, where the commissions, registers, papers of all sorts, sometimes the logs, and the British Libels of our own Continental Navy, privateers galore, and merchantmen of America repose and beckon for help. There would seem to be enough of our own capable naval officers at liberty ashore under pay, who could spend their time to advantage in this way as any other, or if that pro-

ceeding is not regular or capable of being construed as practicable or advisable, then there are surely others whose experience and capabilities in this direction could be advantageously utilized. There were British Courts at Jamaica, Bermuda, Halifax, Antigua, and doubtless other British possessions, where American vessels were libelled at that time. In addition to all this, we read in various narratives, as well as official reports and diplomatic correspondence, that a great many British prizes were taken into our beloved France, and there were certainly French Admiralty Courts for that special purpose where similar history is probably lurking and crumbling, unless the French Revolution and Napoleonic Wars were causes of its destruction, which can readily be found out. Even so, if French publication laws existed, their records should be thus available from their newspapers.

These would seem to be most likely and reliable origins of the naval history of our beginning as a nation. Then if the individual manuscript and private letters scattered about our own country can be accumulated for the twenty-five per cent balance, so much the better.

The records of Great Britain are perhaps better in some respects than those of our own crude Prize Courts set up in our colonies, because the captains' logs and muster books of the British Navy give the details and crew lists of American captures as well as a systematic line of questions and answers and depositions that left no stone unturned concerning the occasion of a given capture or other disposal of a rebel. If it was prison, those details are shown, and all we have to do is to go after it, and that seventy-five per cent guess may be surprisingly enhanced—and if one had the time and money, or orders to do it, on regular pay, much of this history is waiting to be secured before it goes to the junk heap. If it had not been for such natural recording apostles as Esek Hopkins, Nathaniel Fanning, Richard Dale, and C. Lunt, and a few others, we would not now possess what records as do exist of the early beginnings of our Navy and maritime history, but what we need are these strong reliable and more or less complete evidences of the big remaining majority of the unknown and unlauded naval officers, their men, and their exploits, something besides J. P. Jones, and there is a lot of it waiting, as above noted.

It is not even beyond a reasonable comprehension to presume that if these suggestions could be properly presented to the British authorities at this time when the 150th anniversary of our birth is so near at hand, that the huge collection of original documents themselves might be donated to our country. There is plenty of it in the Public Records Office, dusty and mouldy with age, in bundles, in logs, in muster books, in libel papers, in custom house records prior to hostilities, and doubtless in France as well, though this knowledge is not definite but subject to investigation, as are also the West Indian ports and their maritime archives, including Guadaloupe and Martinique.

Three Toasts

(See page 306, February, 1926, PROCEEDINGS)

C. G. WILLIAMS.—On page 306 of the February issue is an article "Three Toasts" by Commodore E. B. Underwood, U. S. Navy, Retired. On page 309 is a note by the author relative to the author of this toast.

The same toasts are given in two volumes of recitations by different collectors as being first used by John Fiske.

The first lines begin: "Among the legends of the late Civil War there is a story of a dinner party given by the Americans residing in Paris, etc." The remainder of the two articles are the same up to "Long continued and tumultuous applause," page 308.

The Naval Staff Afloat

(See page 249, February, 1926, PROCEEDINGS)

CAPTAIN W. S. ANDERSON, U. S. NAVY.—Captain Wygant has called attention to a great need. There should be a fundamental standard organization for an admiral's staff, based upon functional lines. Not only should the various divisions be defined, but under them their appropriate sub-divisions and sections. If logically conceived this could then, of course, be reduced to a graphic plan. In fact it would probably have to be worked out using a graphic method.

Defining such an organization naturally carries with it the idea of assignment of specific zones of responsibility to the various divisions and sub-divisions and sections. This would call for regulations and instructive matter, that, with the organization outlined, would constitute an Admiral's Staff Manual. This should be a standard publication for the Navy, just as is, for example, *The Manual of Torpedo Fire.*

Service both as flag secretary and flag lieutenant, as well as not unsympathetic observation of staff work, has convinced the writer of the Navy's need of such a manual. And it is needed notwithstanding the great improvement in staff work in recent years, for the need is one of organization.

While the Navy could not blindly follow a staff organization outlined by the Army, due to some inherent differences in the way the two services function, Army publications on this subject should be of use in preparing for our Navy the first Admiral's Staff Manual. Many years ago I saw a book prepared for the guidance of Army staff officers, that should have had its Navy counterpart.

Of course the Navy is not absolutely bereft of staff instructions of a kind, nor of experience from which a start can be made. Being interested in this subject, the writer obtained a few years ago a copy of the Staff Instructions issued in 1922 by the Commander of Battleship Squadron Four of the U. S. Pacific Fleet. It is a nineteen page pamphlet. Similar and more recent publications that are no doubt in existence, illuminated by

the idea set forth in Captain Wygant's paper, should be helpful in the task of preparing a standard manual.

Anyone reading Admiral Jellicoe's books will be impressed by the fact that his staff was carefully organized. Forethought and plan had provided a battle bill for his staff that made sure no important duty should be neglected in the din of battle.

He says, for example, in *The Grand Fleet 1914-1916*, page 359, in telling of the Jutland Battle:

> At a sufficient interval before it was considered that the torpedoes fired by the destroyers would cross our line, a signal was made to the Battle Fleet to turn two points to port by sub-divisions. Some minutes later a report was made to me by Commander Bellairis (the officer on my Staff *especially detailed* [Italics mine. W. S. A.] for this duty and provided with an instrument for giving the necessary information), that this turn was insufficient to clear the torpedoes, as I had held on until the last moment; a further turn of two points was then made for a short time. . . .

Only by such a manual, providing not only for peace and war duties, but for actual battle duties as well, can we be sure that essential points will not be neglected. And only by such a manual can the best practice of the past, modified by the experience of the present, be handed along for the benefit of future admirals and their staffs.

The preparation of such a manual is an appropriate task for the present existing staffs. Their efforts, reconciled and reduced to definite form in the shape of a tentative manual, under the direction of the commander-in-chief of the fleet, should then be forwarded to the chief of operations for consideration by his office, and eventual issue to the service. Like any other service manual it should be considered, not as a finished product, but as the expression of present approved practice, subject to, and inviting the constructive criticism of the officers of the service. It should from time to time be revised in the light of experience and study and such helpful comment.

There is a certain satisfaction in suggesting a task for the admirals' staffs, for generally it works the other way, and they allot tasks to us.

The primary idea of Captain Wygant's paper is that the staffs need a standard organization, with a logical and functional distribution of duties within the staff. This is of course the big point. But there is an important corrollary. That is, the delimitation of proper staff work, as distinguished from the regular line work of the fleet or force itself, is important. Staffs are vitally necessary. Then not only assist the admiral, but in their legitimate field can and should assist the force by doing that "overhead" work which is properly theirs.

We all know that admirals and their staffs should not interfere with matters of internal ship administration. Such matters are in the province of captains. But do our admirals' staffs fully realize their obligations to *help* the force, as well as direct it? Inspection that brings with it sympathetic counsel and advice. based upon greater experience, and passing along good ideas gleaned from other units inspected is helpful.

And one small item in the regulation in such a manual could well be that a staff officer should collate and digest information he may need from the regular reports received, preferably copies of reports submitted to the Department, and that he should seldom if ever find it necessary to call on a ship for special, detailed reports. Such work is staff work, and staffs should do it.

Paper Work

(See page 294, February, 1926, PROCEEDINGS)

CAPTAIN H. C. DINGER, U. S. NAVY.—Commander Whiting deserves special credit for bringing up a matter that appears to be running riot in our service; that is, unnecessary paper work. We have it and we certainly ought to rid ourselves of some of it. Some of the examples cited are very pertinent, but there are many others both ashore and afloat.

The paper work incident to obtaining authority to do work at navy yards is very burdensome and rather clumsy. It causes waste and does not tend to economy. No useful purpose is served by the unnecessary complication. The new system of individual requests makes more work everywhere at navy yards as well as on board ship. The sending of repair requests through force commanders and other officials afloat is unnecessary and is a basic mistake. Repair requests should be submitted direct to the yard that is to do the work. Separate requests for each item are unnecessary and are objectionable. Lists of items under each bureau serve the purpose better. The navy yard and the bureau concerned are the only essential authorities that can really decide anything as to repairs.

Endorsements on repair requests from force commanders and other officials afloat are usually perfunctory and decide or determine nothing, often they are not received till after the work is done. Only very seldom do they give any information of use to the yard concerned. The only real factors that count in navy yard repair work are intelligent action by the yard and cooperation with and by the vessel. What the yard wants is not a mass of individual requests with numerous perfunctory endorsements, but an intelligently prepared list of the work that the vessel considers necessary, together with helpful and intelligent information, verbal or written, from the vessel as to the nature of the work involved. Priority of jobs on any vessel can be arranged very easily between the yard and the ship. The money and time available are the real determining factors. The material readiness report appears to be an excellent method of keeping division and force commanders afloat and the Navy Department informed of the material condition of a vessel. They might also be used by the navy yards as a basis for authorizing repairs but would have to be supplemented by repair lists for new items or those requiring further explanation.

Paper work and paper work systems should be useful tools and assistants, not unreasoning masters. When they serve no useful purpose they should be done away with or modified so as to maintain them in the utilitarian status.

Excessive and unnecessary paper work is to be encountered in nearly all of our offices. Attempts to reduce this are seldom successful. The writer has met with slight success occasionally in small matters. It seems to be based on a misconception of what is necessary or desirable and what is non-essential. There is also much duplication. Many separate reports could be eliminated by the use of extra copies of other reports or of log sheets or summaries that go into the various logs. Much of the unjustified paper work is caused by remnants of control or follow-up systems started during the war that have fallen into disuse but are not abolished as they should be. Naval activities are constantly in receipt of circular letters about matters that that particular office is in no way concerned. This means unnecessary paper work. An inspection office for instance is not particularly interested in the distribution and accounting for moving picture films or books in ships' libraries, etc., etc.

Many long letters containing routine instructions are typed where a printed form could be used which would make a better record and save typewriting. We still use reports in the shape of bound books that must be written in long hand, where no copy is made. The aircraft engine log book is an example of this. A recent attempt to get up a comprehensive loose leaf system for engine log book and routine engine reports, which would have reduced clerical work to a considerable extent and given much better records, could not be put through, the reason being there was too much work already. The suggested system would have required less work for all concerned. A little extra effort to start the new system was all that was necessary.

I have several times seen a similar experience to that related on page 299 where some long winded report, due to the press of other work was not sent in for months with no call down. Yet, when a recommendation is made that the report be omitted, it is not authorized. I have never been in an office where an intelligent effort to eliminate useless paper work did not result in increased efficiency, nor have I ever come to an office on duty where considerable unnecessary paper work was not being done. The best criterion of the efficiency of an office is the prompt action on the papers passing through. When an ordinary answer, yes or no, or the forwarding of a piece of information known to be on file requires more than a month, something is wrong add the chances are that the office concerned has been overwhelmed with unnecessary and unjustified paper work.

One possible reason for extra paper work is that in many cases the office force is not provided on the basis of the work required to be done. When the office force is larger than absolutely necessary, non-essential things are sometimes done to keep the force busy and retain them. When the office force is just adequate to the essential work, unnecessary work is left alone, but often the offices provided with an abundance of force make work for those not so provided. A proper adjustment of office force to the actual needs will tend to cut down unnecessary paper work.

In regard to the comment as to the title B nuisance. The simple, sensible, and economical solution for this is to abolish *Title B* altogether.

Surveys of title B articles viewed as a whole are a rather ridiculous procedure for which there is no real justification. It is about as up-to-date as a boarder's pike. Something much more sensible and simple can readily take its place. Nothing like it is to be found in any system of accountability used by large industrial concerns. Most of what is now title B can be made title A and the small and less costly items can be title X. The title B system is supposed to guard against loss and wanton destruction. This it does not do. It is very easy to beat the system. Commander Whiting has indicated some examples. The writer could relate many others. Its records are full of inaccuracies and the whole system is not very seriously treated by the naval service and is regarded more or less as a nuisance. It complicates the accounting system, delays outfitting and repairs to equipment. If anyone has a good word for it or a reason for its being, I have never heard it during my service of over thirty years. Somehow, no one in authority has had the courage or ability to kill it. It is worse than the nuisance taxes because it brings in no revenue.

Navy yard shops get along without title B or P and with no regrets. Why burden our ships with this nuisance?

I fully subscribe to the last paragraph of the article. Fully thirty per cent of our present paper work would fail to pass muster. Would not an order something like the following be likely to bear productive results?

TENTATIVE ORDER FROM SECRETARY OF THE NAVY TO BUREAUS, NAVY YARDS AND STATIONS

SUBJECT.—Reduction in work required of Classified Force.

1) In view of the fact that the classified force that can be employed by the Navy Department is very limited, it is desired that all proper efforts be made to avoid any unnecessary work that requires the services of this force, in order that the performance of absolutely essential work may not be jeopardized.

2) It is desired that every effort be made to simplify correspondence and reduce clerical labor wherever this may be practicable without loss of efficiency. Great care should be taken by officials of bureaus and other administrative offices who may initiate action involving clerical, drafting, planning and estimating work, that this be restricted to that absolutely necessary and essential for productive naval work. Requests for unnecessary information, plans, estimates or investigation should not be made.

3) It is desired that all administrative officials exert special zeal to improve their individual systems and methods of handling correspondence so that the need for clerical labor can be reduced both on shore and afloat.

4) It is directed that all bureaus and other administrative offices of the Department carefully investigate the routine and special reports now required to be made to them by stations and vessels, with a view to cancelling any that may be obsolete or unnecessary; to determine whether others may not be submitted at greater intervals or combined with other reports so that the preparation and filing of these reports may be simplified. It

is also desired that reports of similar nature required by different bureaus be prepared in a uniform manner.

5) The Department has, during the past two years, established a standard filing system for correspondence. It is believed that the general use of this system will greatly lessen clerical labor and simplify the filing problem. It is hoped that further standardization of clerical and drafting work may be worked out by the various bureaus to the end that the greatest amount of useful output may be secured for the limited force allowed to the Navy.

The principal causes for unnecessary paper work appear to be lack of proper knowledge of the whole situation by those who institute the paper work or continue it beyond the point where it has outlived its usefulness. Everybody criticizes the unnecessary paper work and many of us also criticize some that is useful. If we eliminated the useless and unnecessary we might be better contented to carry on with that which is useful and necessary. Useless and unnecessary paper work is a sign of inefficiency and of a deteriorating administrative ability as stated by Admiral Rodgers in his discussion. As money becomes more scarce, paper work appears to increase. As we do less we apparently have to write more about it and explain why we don't do more. Too much centralization and a tendency not to permit local authorities to act on their own judgment and initiative is responsible for extra paper work, particularly in regard to naval material.

Some reformer with proper ability and authority can do the Navy a very good turn by relieving it of the burden of useless and unnecessary paper work. Perhaps the continued scarcity of funds may force us to reduce, at least to some extent, this wasteful practice. My complaint is not against paper work that is necessary or that serves any useful purpose, but against that which is a useless burden and for which no sound justification can be given.

Paper Work

(See page 294, February, 1926, PROCEEDINGS)

COMMANDER R. R. SMITH, U. S. NAVY.—The writer of the above paper makes comment upon the method of expending title B articles on board ship. It may be of interest to note that the undersigned made substantially the same recommendations about three years ago which were approved by the commander battleship divisions and forwarded to the Department, where they were disapproved by the Bureau of Supplies and Accounts. Prior to the inclusion of the value of surveyed articles in the charges made against the ship's allotment, there existed every reason to carefully guard against the unnecessary surveying of the title B articles. Under the present system of accounting, the value of such surveys being charged against the ship itself, the head of the department concerned is probably the most vitally interested person in guarding unnecessary surveys and the consequent depletion of his allotment. It is difficult to understand why the head of a ship's

department is not sufficiently competent to pass upon any article of equipment without calling upon the services of a board outside of the ship. Officers afloat spend a great deal of time on board other vessels attending to minor surveys which time might be used to better advantage on board their own ships, and it is doubtful whether any good is accomplished thereby. If one survey board declines to survey an article, the usual practice is to place it upon another survey where it is eventually approved. In my recommendations, I think that I set the limit at $250.00 or thereabouts, but instead of transferring these articles to title X, recommended that they be retained at title B, in order that the ship's allowance of spares, and so forth, might be kept filled, but that they be expended from the books as unfit for use upon the signed certificate of the head of the department to the supply officer. The expenditure of large sums of money would be guarded against by the calling of a survey board for items above the amount of $250.00. There should probably be a closer investigation of missing articles, and it was recommended that the limit be placed at $50.00, beyond which point a survey board would be called. The usual experience in placing responsibility for missing articles is to place responsibility upon some officer who has been detached, and the correspondence usually follows this officer to some distant port, eventually to be returned with a satisfactory explanation.

One of the chief causes of excess paper work is the lack of recognition of the fact that certain reports have served their purpose and should not be continued. I believe that every office, both ashore and afloat, might well scrutinize all of their reports with a view to eliminating some of them, or at least reducing their size. The best test of a report is to note the effect upon the work of the office concerned, if the report is not submitted. Economy in paper work is like economy in anything else—if every one makes some reduction, the aggregate reduction will be very noticeable.

On the other hand, reports are necessary and essential, and it is a mistake to condemn all paper work. By making every one realize that his report is used, and is necessary, fewer objections will be heard to submitting the required reports.

Excellence of Naval Material

(See page 1740, September, 1925, PROCEEDINGS; pages 1961, 1963, 1964, October, 1925, PROCEEDINGS; pages 2164, 2165, 2167, November, 1925, PROCEEDINGS.)

LIEUTENANT COMMANDER F. S. CRAVEN, U. S. NAVY.—Seven discussions of "Excellence of Naval Material" (September, October and November, 1925 PROCEEDINGS) provide valuable material for strengthening the case against the existing Navy Department material organization. As Commander McDowell rightly observes, the chief purpose of the article is to improve this organization; but improvement of personnel training and specialization also are purposes.

There is much justice in Commander Shafroth's objection to the length of the article and Commander Schuyler's criticism of its great detail. Doubtless these characteristics deterred many from reading it and perhaps confused others as to its aims. Friendly critics who examined the article before it was submitted warned me of these dangers.

But in preparing the article I was handicapped because, although there are numerous instances of poor naval material produced under the existing organization, they are so serious in nature that I felt they should not be discussed in any open publication such as the PROCEEDINGS. This deprived me of a concrete base for criticising the existing organization and made necessary a complete and thoroughly supported abstract analysis of principles to serve as a substitute.

Thus, sections II to VIII of the article consider all aspects of the development of naval material, including those which are at present well handled as well as those poorly handled. I considered this necessary for soundness; but it appears to have been misunderstood by Captain Dinger who comments several times to the effect that what is advocated already exists. He also in several instances remarks that existing agencies are satisfactory. While those mentioned may be perfectly satisfactory under the existing organization, they naturally might have to be changed to fit into an entirely different type of organization.

Six discussions find both good and bad in the article, but the seventh, by Commander Schuyler, apparently finds it only bad. As a means of lessening confidence in the reasoning and conclusions of the article his discussion is distressingly clever.

To say something good of the article, Commander Schuyler concedes at the start that in any event it "is useful as an illustration of orderliness of thought." He then puts on their guard those, inexperienced in Navy Department affairs, who might perhaps otherwise be unduly impressed by its detailed length and style. He explains that it could be refuted in detail, but doubts if this will be done because of the labor involved. He makes the suggestive, although unsupported assertion that my premises will bear looking into.

Commander Schuyler then takes up the only point in the article which he specifically considers, and in so doing conveys a wrong impression of its meaning. Probably I am to blame for failing to make the meaning clearer. At any rate, he gives the impression that by "design centralization" is meant actual physical grouping of engineers and draftsmen in one room, whereas the term really applies to centralization of *control* of design.

In concluding his subtle attack Commander Schuyler concedes probable imperfections in the existing organization but, speaking for the majority of those competent to judge, he does not feel that these have produced results sufficiently bad to warrant changes. He indicates (and with much truth) that drastic changes such as I recommend would produce turmoil and complications, apparently wishing his readers to infer that these would work more harm than do the imperfections which he concedes.

As a means of controverting this reasoning let it be assumed that an organization can be developed which is better than the existing one; and let this improved organization be substituted. The resulting turmoil would be only temporary, and since it is admitted that the new organization is better than the old, it follows that the complications would soon be ironed out. The bad results from making the change therefore would extend over only a brief period of time whereas those resulting from the imperfections in the old organization would have gone on continuously so long as it remained in effect. Obviously only a slight margin of improvement would be sufficient to justify making this change.

But our present organization is so seriously faulty that to deny our ability to improve it, not slightly but very greatly, is to deny the existence of normal American ingenuity and good sense in the commissioned personnel of the Navy. In the article I have attempted to demonstrate some of the faults of the organization upon a basis of abstract reasoning, but I realize that this is not enough. Therefore on December 22, 1925, I forwarded to the Navy Department a letter presenting a considerable number of serious instances of faulty results produced by the existing organization. These are mostly operational and military design faults in our ships and their appurtenances, and represent only matters which have come directly within the purview of my own experience; doubtless with wider experience I could have presented an even more convincing list. I have requested confidential publication of this letter to the service for consideration and discussion, and if this be found practicable I am confident that it will prove the soundness of my criticisms of the existing organization, if not of my suggested changes to improve it.

The discussions will now be considered collectively, with regard to specific issues raised in them.

The Division of Naval Material. The proposal to merge the technical activities of the several bureaus into a single Division of Naval Material was approved by all commentators except Commander Schuyler who did not specifically discuss this point, so I hasten after the manner of Clemenceau to cry "adopté!"

Functional Organization of this division, instead of the present classified organization, is specifically approved by Captain Wygant, Commander McDowell and Commander Howard. By inference, Commander Fisher also appears to approve it, but Captain Dinger and Commander Shafroth seem to favor the present classified bureaus under a Chief of Naval Material who is to coordinate their activities.

What is needed, of course, is coordination of the classes of material in order to get improved ship design. Coordination of the functions is not necessary because their interdependence (see Chart I of the article) forces a natural cooperation which is virtually an automatic coordination.

The following comparison of the two types of organization shows their relative advantage as regards coordination of the classes of material and in other respects.

A functional organization of the Division of Naval Material would have the three main heads of design, production, and maintenance. In the article I have called these bureaus, but with Commander McDowell I would welcome a better name. Each of them would have subdivisions for the classes of material, such as ordnance, hull, propulsive machinery, and the like. It is apparent that a principal and natural duty of the chief of each would be coordination of the classes of material. Then, since coordination of the functions would be virtually automatic (although in this connection refer to page 1596 of the article) it follows that the big chief, the Chief of Naval Material, would be relieved of details of administration and would be free, with his staff, to concentrate on "the larger problems" which, in this case, obviously would be conceptive work.

On the other hand, a classified organization of the Division of Naval Material would consist of classified main heads similar to the present bureaus. These would ordinarily have functional subdivisions. With this arrangement the duty of coordinating the classes of material would fall directly to the big chief who would have to delegate the work to his staff. This would impede the staff, and also the big chief, with administrative work. The vitally important coordination of the classes of material would be inefficient because the staff would have to function as inspectors, and to effect coordination would have to work back through the big chief and the chiefs of the bureaus, with consequent lost motion. A very large staff would be required for this coordination alone.

The very great advantages which are seen to lie with the functional form of organization suggest that if a single division were to be formed by placing a responsible head over the present bureaus, this officer would soon reorganize on functional lines.

Conceptive Planning By An Individual Instead of A Committee. This subject is discussed by Commanders Howard and Shafroth. The former agrees that conceptive work by an individual has greater prospects of brilliancy than if done by a committee, but he fears "brilliant failures" such as the British cruisers which he names. He concludes that our present method of committee (General Board) conceptive work would give better *average* results, apparently because he feels sure that they would not make serious mistakes, although he admits that they would tend toward compromises.

Is not this attitude rather negative in character? Refer to the discussion of the functions of the proposed board of review (essentially the General Board) on pages 1581, 1582, 1586 and 1625 (4) of the article. It is not apparent how, under this plan, unsound conceptions could get past the board of review which would not, under the present system, also get past the General Board.

Commander Howard appears to feel that it might not be possible to find an officer of sufficient calibre to fill the assignment of Chief of Naval Material in my proposed organization. So does Captain Dinger who says "Combining all material matters under some definite head would be desirable, but who is to do it? This is a nut to crack!" The same idea has been ex-

pressed to me orally by others. I think the most convincing reply consists in asking another question: How do we dare appoint a single officer as Commander in Chief of the fleet?

Commander Shafroth objects to the idea of incorporating major conceptive planning under the control of the Chief of Naval Material, on the ground that this officer would be a "material man," likely to give too much attention to technical and not enough to strategical and tactical considerations. I am inclined to feel that this criticism is well taken, but that his cure for it, which is to retain the present system, can be proved faulty both theoretically and by the practical results it has produced. For the theory see pages 1579 to 1581 of the article. Practical proof is contained in abundance in my letter to the Department of December 22, 1925, previously mentioned.

I should think a good solution would lie in the adoption of a real general staff system for the whole navy. The functions of a general staff are conceptive planning and coordinations. The conceptive agency described in my article is really a general staff for material. If we had one instead for the whole navy, it would consider material along with, and with respect to operation and training, with manifest advantages.

Technical Corps. Both Captain Dinger and Commander McDowell do not regard a technical corps as necessary, although Captain Dinger makes certain reservations (as to naval constructors and civil engineers) which appear to me to weaken his case. However, the ideas of these two officers do not appear to be quite the same. Captain Dinger apparently feels that most line officers can also be technical specialists in lines well suited to their natural abilities, whereas, if I understand him rightly, Commander McDowell really proposes to have several groups of purely technical officers serving nominally in an all-inclusive "line." He appears to feel that this plan would be very flexible, enabling the available personnel to be manipulated to suit the prevailing requirements. It also would permit a reshuffling of younger officers as often as necessary to ensure that they have really found their bents before confirming them in their specialties.

This idea of Commander McDowell's seems rather similar to the plan advocated some time ago when amalgamation of the staff corps with the line was being discussed. It has manifest advantages, one not so far mentioned being elimination of any line-staff corps feud which may still exist. However, there are two rather grave disadvantages. One is the danger of domination of the whole line by one of its special groups. The other is the need for constant and highly intelligent vigilance and good judgment, to administer properly this highly flexible (and therefore dangerous) organization, but the great difficulty of keeping up this delicate control under the handicap imposed by the regular shifts of personnel which are inherent in the Navy.

These disadvantages are real. They would not usually be found in a great commercial organization because its controlling personnel would be relatively permanent. But for the Navy they are so prominent as to make this plan of doubtful advisability in spite of its advantages.

Commander McDowell also mentions frequent tours of sea duty for technical officers. In this connection refer to page 1610 on which reference is made to technical officers at sea on repair ships. They also should serve on important staffs afloat. These assignments would not break them away from technical work, as is now done when our combination line-technical officers go to sea as deck officers.

As regards Captain Dinger's idea, I refer to the discussion on pages 1598, 1616, 1617, and 1619 of the article, which brings out the inherent incompatibility of line duty (involving intermittent sea service) with technical ability of the grade the Navy requires (which necessitates continuous technical application). The article rather stresses the technical aspect of this, and I am glad of this opportunity to stress the line aspect.

Item 12 on page 1619 of the article refers to line problems. These consist of problems in the basic operational specialties (gunnery, torpedo control, bombing, ship propulsion, ship control, and communications), in the superior operational specialties (strategy, logistics and tactics) and in staff organization and administration. The problems in each of these classes are comprised under the heads of determining principles and developing methods of applying them.

The vital importance of correctly solving these problems apparently is not fully recognized. If it were we would send our younger line officers to schools to learn the principles and approved methods of application of their line specialties, instead of trusting to their individual initiative, judgment, and energy to evaluate correctly huge masses of undigested ideas and experiences which we now set before them (as in gunnery) or detailed written instructions which we hope they will read. We would intensify the importance of the Naval War College and would include in it a school to develop competent staff officers after the Army's practice, instead of allowing our line officers to elect to go to the college, as we do now, and letting our staff officers just grow up, like Topsy. We would not reduce the efficiency of so many of our best line brains by requiring their possessors to be both technical specialists and line specialists; instead we would assign some of them to each specialty, freeing them all from the conflicting pull of incompatible requirements as well as reducing the scope of their activities to the point where true expertness could be developed.

The improvements which would result from these changes would be very marked in both line and technical work, but what I am stressing here is the line aspect. We would, first, acquire well developed and generally understood codes of operative principles; second, we would develop sound and efficient methods of applying them; finally, our line officers would be *trained*, and thereby fitted to derive correct conclusions from their subsequent experience in practical work. It is from this application of a *trained* viewpoint to practical experience that would arise a well directed urge toward that continuous evolution whereby our tactics and other essential line functions can be kept at maximum efficiency.

I recognize, of course, that only a certain proportion of our officer personnel can be sent to postgraduate schools. Our present policy sends this proportion so largely technical schools that we would not be able also to support operational (that is, line) schools in gunnery, communications, and the like. The best cure for this would be to secure from Congress an increased number of officers so that more could go to school at a time. In this way the Naval Academy would be the basic reservoir for both line and technical officers, but there would be two complete systems of postgraduate schools so that line specialists would be as well trained as technical ones. If this increase of officers could not be secured, or else a larger proportion of officers be made available for schooling, as by decommissioning ships (in this connection, a proper reorganization of the Navy Department should release for other service a considerable number of officers), then the problem could be met by recruiting our technical officers from college graduates and putting them through a postgraduate course at the Naval Academy, in lieu of the course for midshipmen. The proportion of commissioned officers which now attends technical postgraduate schools could then attend operational schools.

The Power to Coordinate is commented on by Commander Fisher with whose remarks I am in thorough agreement. He stresses the connection between direct control of funds and power to coordinate—the latter cannot exist without the former. The Chief of Naval Material must have the sole responsibility, under the Secretary of the Navy, for the expenditure of material funds.

Line Supervision and Control of Design Development. Commander Howard believes that line supervision and control of design is not practicable; but I feel that his conclusion must be based upon his understanding of what is meant rather than on the intended meaning, because I know from direct experience that the proposed plan will work. Apparently with reference to the same subject, Captain Dinger comments upon my apparent inexperience in connection with the actual design and construction of vessels.

Since these conclusions, especially when as stated by Captain Dinger, would tend to discredit the article in the minds of those readers who had not had direct design experience, I feel that I am warranted in reciting personal experience as a means of clothing the article with such psychological armor that it can resist attack other than against faults in its logic. I will state, therefore, that I served a tour of duty in a technical section of the Bureau of Ordnance during which my chief duties were in connection with design. I worked with civilian engineers of the bureau and at the Naval Gun Factory, and also with engineers representing several commercial firms. As regards ship design, student officers under instruction in naval architecture at Massachushetts Institute of Technology have developed to my specifications the detailed designs of a torpedo vessel (enclosure C of the letter of December 22, 1925), and were kind enough to permit me to exercise supervision and control over the incorporation of the operational and military features.

Wherever the circumstances permitted, I worked with the technical designers along the lines advocated in the article, and I can say that where this was possible the ultimate results were best. As regards the torpedo craft design, all elements of my general design except a gyro stabilizer were successfully and exactly incorporated, and I speak with the approval of the officers who developed the design (they had read the article) in stating that this "line supervision and control" worked well. Naturally, the question of personalities of those involved is important, just as it is with the present organization and methods of administration.

Personnel Considerations. I am happy to note the endorsement, particularly by Captain Dinger, of those parts of the article which refer to personnel and specialization. It was as a means of including these in the article that it was given its broad title.

General. I have failed to comment specifically on a number of points of importance brought up in the discussions, either because the remarks made by the commentators are sufficient in themselves and in agreement with my own ideas, or because the objections of one are answered by arguments presented by another. An illustration of the latter is the explanation by Captain Wygant of my meaning in decrying surrender to money limitations, which is the best reply possible to the comments under this head by Captain Dinger who apparently misunderstood my meaning.

National Policy and Naval Power

(See page 229, February, 1926, PROCEEDINGS)

THE INDISPENSABLE NAVY

New York *Herald-Tribune,* 5 February, 1926.—In the February number of The United States Naval Institute PROCEEDINGS Mr. William Howard Gardiner, writing on "National Policy and Naval Power," re-emphasizes the inescapable military truth that it can never pay a first-class naval power to maintain a less than first-class navy. By the Washington naval armament limitation treaty the United States established its right to share sea primacy with Great Britain and to be ranked in naval strength ahead of all other nations. The 5—5—3—1.75—1.75 ratio determines our naval development. We ignore national advantage and all the teachings of naval history if we fail to live up to the privileges and obligations of this sea status.

Naval warfare never pardons inferiority. A neglected first-class navy quickly becomes second class and the investment in it is impaired or sacrificed. Deficiences which look unimportant may turn the scale in a navy's fighting capacity at the decisive moment. Then a merely "good enough" navy becomes a peril to national safety. It is Mr. Gardiner's contention—one justified by the facts which he marshals—that our Navy is not up to the strength needed to meet its responsibilities in the Pacific. In that ocean our strategic position is highly unfavorable. We have an invaluable insular possession—the Philippines—lying on the Asiatic side and we are gravely handicapped in defending it. Our Navy lacks adequate

Pacific bases. We have a 5—3 superiority over Japan in capital ships. But that advantage is offset by Japan's proximity to the Philippines and to Guam and by Japanese superiority in cruisers and submarines. Our naval strength in the Pacific compared with Japan's, is not now 5 to 3. It can hardly be considered even 4 to 3. It remains below the treaty ratio, mainly because the United States has not overcome shortages in certain classes of auxiliary ships, construction of which is not restricted by the Washington treaty.

A navy, to fulfill its mission, must be able to command the sea and then to control it. For command, a superior battle fleet is required. For control, a superior fleet of cruisers, submarines and aircraft is needed. We do not have both, as Mr. Gardiner points out. If the two battle fleets were merely to contain each other for an indefinite period, we should not be able to exercise that control of the Pacific area necessary to enable the superior power to bring that decisive pressure on an enemy—namely blockade—which naval strategy contemplates.

According to Mr. Gardiner's figures, after attempting to allot adequate auxiliaries to the battle fleet, the United States control force would be minus eight in modern cruisers, minus fourteen in large submarines and plus 189 in destroyer type. Japan's control force would be plus thirteen in modern cruisers, plus eleven in large submarines and plus forty-four in destroyers. Considering the fact that modern cruisers far outrank destroyers in offensive power, this is a disquieting contrast.

The writer says:

> We not only have no effective control force in addition to the requirements of our battle fleet, but even the battle fleet lacks eight cruisers and fourteen fleet submarines. That is to say, our battle fleet itself is so deficient that grave doubts are raised of its ability to proceed with reasonable safety to Manila Bay, or to any remote base in time of war. In order to secure the command over such a critical area that, of necessity, is the preliminary to the conclusive control operations therein, whereby naval power engenders in an enemy country the conditions that compel collapse.

For the purposes of safeguarding our future in the Pacific the American navy falls below its proper standards. Economy which keeps it under ratio strength and under national defensive needs is not helpful economy. The navy, unlike the army, is an instrument which must be kept ready for instant use. Its value depends on up-to-date preparedness. Slackened maintenance involves a weakening of this country's moral influence to preserve peace and a clouding of the prestige which deters aggressions. Our most vital form of national insurance should not be allowed to depreciate or lapse. With all possible stress laid on constructive economy in other departments of the government, sound policy demands that the navy be always kept at the peak of its treaty strength and strategic efficiency.

National Policy and Naval Power

(See page 229, February, 1926, PROCEEDINGS)

OTHER NATIONS' ENVY AT GROWING U. S. TRADE ABROAD MAKES BIG NAVY VITAL, SAYS HINMAN

BY GEORGE WHEELER HINMAN: The *Washingon Herald*, 6 February, 1926.—The United States sold some $5,000,000,000 of its surplus products last year. The United States, in its whole foreign trade, handled 100,000,000 tons last year.

These are the new and corrected figures. What would happen in the United States if this trade should be suddenly reduced—cut in half—by foreign trade rivals?

What would happen in the United States if, by the misfortune of defeat, the enormous sale of American products abroad should be frustrated, as in the case of Germany after the war?

What would happen in American industry and business if $2,000,000,000 or $3,000,000,000 of the surplus now marketed abroad should be thrown back on American business and industry?

The answer is plain. The same things would happen to men in business and industry that has happened and is happening to farmers with surplus crops. Hard times would engulf us all.

These ideas are suggested by a pamphlet that came to hand yesterday The pamphlet is by William Howard Gardiner; the title is "National Policy and Naval Power." It might well be "Naval Policy and the Nation's Business."

Day by day the United States Navy is squeezed down and pared to the bone. The process is going on now—today. Few business voices are raised against it. Many business voices are raised for it. Yet Gardiner shows that, without a strong Navy, there can be no assurance that this foreign trade can be defended, maintained and increased as the welfare of the people require more urgently with every passing year. Why not?

Because, this huge foreign trade, by which the United States gets rid of its surplus, is sought eagerly, even fiercely, by every other great nation.

Because, in the struggle, every other great nation resents our protective tariffs and would break them down if it could or dared.

Because, in the same struggle, every other great nation wishes to set aside the laws that protect our vast coastwise shipping and desires to take the coastwise business away from us for the benefit of its own people.

Because, in the rivalry for trade abroad, American exporters and salesmen and trade agents have to be supported by the power—not the talk, but the power—of their government if they are to go on marketing the American surplus.

Because—besides and in general—for the prosperity of the land, the United States has limited immigration, excluded those races which cannot be assimilated, has built and taken charge of an interoceanic canal "which now has a traffic greater than the Suez Canal," and has done many other things that are disliked by its business rivals, are objected to by them

in secret, and are to be left as they are only as long as the United States is supposed to have the power to maintain them.

Let no man imagine that the great prize which the United States is winning in world trade is conceded to this country cheerfully, or, in fact, is yet conceded at all. The last appeal against a successful trade rival is force. What happened to Germany?

What, then, is the Navy for? In peace, it largely is the promoter and protector of America's growing foreign business—the bulwark which defends America in the possession of a foreign trade which is destined to excite the growing envy and resentment of every power that is left behind in the race for the prize. In peace, if adequate, this Navy is the assurance not only of safety for this foreign trade, but also of continued tranquility.

If Germany had had twice the Navy, there would have been no war. She could have gone on winning her way in world trade, yet there would have been no war.

There is much propaganda just now in Great Britain against submarines and battleships. Why? Because, with battleships and submarines out of the way, the cruisers would be the thing and, of modern cruisers built and building, Great Britain would have fifty-one to Japan's twenty-five and America's twelve.

And what would this vast superiority in British cruisers be for? For the upbuilding, protection, and assurance of British commercial superiority on the seven seas. That is the British idea—the British way. If a nation's business policy amounts to more than mere cheeseparing and money counting at the week-end aren't these suggestions—regarding a business stake of five billions a year—worth about ten times the attention they are getting from the business men of the United States at present?

THE ROYAL MAIL STEAM PACKET COMPANY'S PASSENGER MOTORSHIP "ASTURIAS" (See Page 764)

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THE ROYAL MAIL STEAM PACKET COMPANY'S PASSENGER MOTORSHIP "ASTURIAS" (See Page 764)

PROFESSIONAL NOTES

ARRANGED BY

LIEUTENANT COMMANDER H. W. UNDERWOOD, U. S. NAVY

FROM 3 FEBRUARY TO 3 MARCH

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GREAT BRITAIN

Naval Policy

The Army, Navy and Air Force Gazette, 13 February, 1926.—The first lord's address at the Constitutional Club last week on our naval policy was a clarion call to vigilance on the part of rulers and people alike. It is well, even necessary, to counteract the tendency to think that the navy can be neglected with impunity during times of peace. Only after a great struggle last year did the government adopt a five-year program of construction which is believed to be sufficient to maintain the Navy on a one-power standard. Whether it will suffice to do so cannot be determined with certainty until the progress of other powers is more definitely known. But, apart from foreign construction, the fleet of today must have some new ships to replace the many which are heading very quickly for the scrap heap, following their hard wear and tear in the war.

It cannot be said that a good start has been made with the 1925 program, seeing that not a single keel has yet been laid of the ships authorized in it. Two of the cruisers were to have been laid down in the public yards in October, but neither has yet been begun. This easy going policy, it should be impressed upon Parliament, is fraught with many evils. Cruisers which ought to occupy only two years, or less, are delayed, and are not to be completed until three years from their commencement. Their final cost is thereby increased, they occupy berths and wharves which could be utilized for later ships, the fleet is denied a year or more's experience with a new type of vessel, and the design of the ships themselves is perhaps outclassed before they hoist the pennant.

The completion of the *Emerald,* which left for the East Indies last Saturday, illustrates the operation of this practice of slow warship construction. Laid down in 1918, the *Emerald* and *Enterprise* were put aside after the war as stand-by jobs, and have thus taken between seven and eight years to complete. They are the only cruisers in the navy which can steam at 33 knots, the only ones, in fact, which can do more than 31 knots. Imagine the amount of tactical experience with this new type which might have been gained during the past five years if they had been completed promptly! The ten American cruisers of the *Omaha* type, begun much later, were finished long ago, five of them during 1923, and the long "shake-down" cruises to foreign parts which they carried out must have yielded valuable data for later ships.

In the matter of seaworthiness, too, there is a great advance between the *Emerald* type and the C class which they are about to replace in the East Indies. All the more reason, therefore, why officers and men should get accustomed to the new class at the earliest opportunity. The C class, hurriedly built in the war, were developed largely from the flotilla leader type, and it is no exaggeration to regard them as mere glorified destroyers. While they were well suited for the North Sea they are certainly not well built to stand the rolling seas of the Pacific or Atlantic. Some time ago, the *Carlisle,* in China, took nineteen days to make a passage which should have lasted only a week. Facts such as these should be kept in the public mind whenever the question of naval appropriations is being considered, for it is misleading and useless to assess naval strength by numbers of ships only.

British Naval Needs

The Army, Navy and Air Force Gazette, 6 February, 1926.—It used to be said that a favorite pastime of certain American politicians was twisting the lion's tail. It seems now that there are some parties in the United States who favor an attempt to cut his claws. The Washington State De-

partment last week notified the League of Nations that it accepts the invitation to be represented on the Preparatory Commission which is to study the program and methods of a World Conference on Disarmament, which meets at Geneva on February 15. The decision has no doubt been received with gratification by that active group who are seeking for a means of revising in favor of America the results of the Washington Treaty of four years ago. More than one attempt has been made to scare the American people into a belief that Great Britain and Japan secured some mysterious naval advantage by that pact, and the belief is evidently entertained that a second conference might be so conducted as to readjust the naval balance which is held to have been disturbed by the Treaty of February 6, 1922.

The fact is, of course, that no nation surrendered more than Great Britain as a contribution to international understanding. Admiral of the Fleet Lord Wester Wemyss well said that for Great Britain voluntarily to resign that naval supremacy which to obtain and maintain she had fought and striven for during more than three hundred years, and the principle of which had ever been the first and foremost article of her political faith, was an act of renunication unparalleled in history. Under the stress of economy, we have cut down our naval power to a shadow of its former self. Now it would seem that further reductions are expected, especially if, as is reported, one of the first points to be urged by the American delegation is the severance of the problem of naval from that of military armaments. How the question of the air is to be decided is not stated. The air force in other countries is not under separate control, as in Great Britain, but forms an integral part of the naval and military services.

The sacrifices often called for by those who talk or write glibly in regard to these conferences show that they cannot appreciate how vital to this country is its navy. The needs of America in this connection are totally different from those of European powers, just as those of the latter are different again from the needs of island powers like Britain and Japan, and Great Britain is in a position which is quite unique by reason of the fact that her empire is scattered all over the globe, and is entirely dependent upon the sea for its existence and protection. No sort of cut-and-dried mathematical formula can give expression to the needs of the British peoples in this respect. Yet at these conferences British representation is often out-voted by that of other powers which have no such vital attachment to the sea. If the proposed conference goes through, and achieves a measure of agreement, by which the financial burden on the peoples of the world is lightened, well and good. But service men will ask that the facts of empire defense be faced squarely, and that the real interests of the country shall not be let down by the politicians.

Many millions of money were supposed to have been saved on the cost of navies by the Washington Treaty. Looking into our own case, what do we find? We are in a much weaker position from the naval standpoint, and how much better off are we financially? Are we, in fact, any better off at all? Or has not much of the expenditure which would otherwise have been used to maintain the strength of the fleet and provide badly needed work for the shipyards gone in measures more in favor with the politicians, whether coal subsides, or education, or new pension schemes, and the like? Signor Mussolini is surely on stronger ground when he expresses the desirability, as at Rome last week, that all the armed forces of the nation should be in a state of full material and moral efficiency. "We wish for peace," he said. "I went, and I would return, to Locarno, but while words of peace flash on the horizon I cannot avoid noticing that the skies are filling with prodigious flying machines and the seas with new naval war units. Our surest peace, like that of the Paradise of Islam, lies in the shadow of the sword." It could be wished that our present rulers understood this better than they evidently do.

Dual Control

London Post.—Perhaps the most important defect in organization revealed by the recent maneuvers is the dual command of the army and Royal Air Force. Sir William Robertson is convinced that the army should possess and control its aerial arm, and that all the talk about co-operation and friendly relations between the two services, however amiable, only serves to distract attention from the absolute necessity of abolishing dual command. It is an axiom in military science that dual control inevitably brings confusion and may result in disaster. The aerial arm serves both for reconnaissance and artillery duties. Because the aerial arm works above the ground and not on it, should it be removed from the control of the army? The same issue arose with regard to the artillery and the engineers; and no one now argues that these should be placed each under a separate command. Sir William Robertson does not suggest that the Royal Air Force should be disbanded, and part given to the navy and part to the army. The field marshal, as a soldier, affirms what every naval officer affirms, the necessity for unity of command. As matters stand, neither the navy nor the army can do its work as it should be done; and it is for Parliament to deal resolutely with an anomaly which ought never to have been created. . . . .

A Dreadnought Anniversary

The Engineer, 5 February, 1926.—The twentieth anniversary of the launch of H.M.S. *Dreadnought* falls on Wednesday next, February 10. Some difference of opinion exists as to whether this vessel or the *Warrior,* of 1861, should rank as the most historic ship of the ironclad era. In our judgment the *Dreadnought* has the better claim to that distinction. The *Warrior,* it is true, was the first iron-built armored ship, but apart from the material used in her construction, she had been anticipated by the French *La Gloire,* which was the first sea-going vessel of war to have armor protection. Nor can these earliest ironclads be said to have exerted on the development of naval warfare an influence comparable with that of the *Dreadnought.* The amazing growth in the power of ships' ordnance, which eventually revolutionized man-of-war design, dates certainly from the introduction of armor; but in its initial stages the metamorphosis was slow, and years elapsed before naval tactics were modified in deference to the new material factors which had come into play. The circumstances attending the coming of the *Dreadnought* were very different, the effect was immediate. In fighting power she was regarded as being so immeasurably superior to all preceding ships that her appearance caused a temporary and almost universal halt in heavy naval construction. At that period battleship design was governed by the lessons of the Russo-Japanese War, in which campaign vessels of conventional type had borne the brunt of the fighting. The dual caliber system of armament still held the field, though the tendency was to increase the weight of the secondary guns, as in the *Lord Nelson,* the French *Danton,* and the Japanese *Aki,* despite the manifest drawbacks from the point of view of fire control. It remained for the bold genius of Lord Fisher to apply the obvious solution to the problem by building the first mono-caliber ship. We use the word "genius" advisedly, for notwithstanding popular rumors of the day which credited foreign experts with having conceived the germ idea of the *Dreadnought,* it is a well-established fact that Fisher had planned an all-big-gun ship as far back as 1882. Sir Philip Watts has offered conclusive testimony on that point. The writings of the Italian constructor, Colonel Cuniberti, which are often quoted as the inspiration of the *Dreadnought's* design, were published more than twenty years later. It is, however, but fair to add that Mr. J. H. Narbeth, of the Royal Corps of naval constructors, has stated in a paper read before the

Institution of Naval Architects, that the arguments of Admiral Sims, U. S. N., made "a very deep impression on the mind of Lord Fisher, and very largely supplied the impetus which determined him to ask for a one-caliber big-gun battleship."

While the tactical superiority of the *Dreadnought* over all her predecessors has never been seriously disputed, the political wisdom of Fisher's action is less generally conceded. The construction of this ship was something more than a landmark in naval design; it was a political event of far-reaching significance. Yet there is no doubt that the beneficial results accruing to us from the *Dreadnought* policy were overstated by zealous partisons of the Fisher school. The British nation was led to believe that its first group of *Dreadnoughts* would give the navy both a decisive and a permanent advantage over all rivals—because other nations were declared to be lacking in the technical resources required for the construction of such monster ships of war. Strange as it may seem today, this naïve argument was advanced in all earnestness by naval critics of repute, and was, of course, widely accepted by the public. Germany, in particular, was assumed to be out of the running, if only because the prodigious cost of enlarging the Keil Canal, which was too small to accommodate *Dreadnoughts*, would be beyond her means. All these facile expectations were, of course, falsified. Germany, after no long delay, began the building of battleships on the new plan, and simultaneously set about the formidable task of reconstructing the canal, a work that took eight years to complete. It is difficult to resist the conclusion that Germany gained more than this country by the introduction of the *Dreadnought*. In 1906 her fleet included ten first-class and ten second-class battleships, the latter being armed with nothing heavier than 9.4-inch guns. We possessed at that time forty 12-inch gun battleships, the oldest of which were fully equal, and probably superior, to the German second-class vessels. Of modern armored cruisers we had thirty-five and Germany no more than eight. All these ships were rendered obsolete by the *Dreadnought* and the *Invincible*, which created new standards of fighting power for battleships and armored cruisers respectively. We had thus to write off, as it were, seventy-five ships against a German total of twenty-eight. But that was not all. The reduction of battle fleets to a *Dreadnought* basis gave Germany a chance to resume the naval race on equal terms, and from 1906 to the outbreak of war she pressed us hard. Her largest pre-*Dreadnoughts* were of 13,200 tons; her first all-big-gun ships were of 18,900 tons, an increase of 5,700 tons. These facts cannot be said to support the argument that in producing the *Dreadnought* we scored any marked advantage over our principal competitor of that period.

It is to be doubted that the world has ever displayed an interest in any other ship of war comparable to that which the *Dreadnought* excited. Though the features of the vessel were supposed to be confidential they soon leaked out, and were freely canvassed in the press. At Portsmouth Dockyard, where the keel was laid on October 2, 1905, the building ship was screened from the vulgar gaze and a special guard posted to keep unauthorized visitors at a distance. Such procedure was new in this country, and its only apparent effect was to stimulate foreign curiosity. The vessel was built in record time, the Admiralty being desirous of testing her at sea before further units of the class were ordered. To facilitate rapid construction the lines of the hull were simplified, care being taken to provide an exceptional degree of rigidity in decks and bulkheads to fortify them against the concussion of the heavy guns. The steel sections were reduced to the smallest number possible; plates of standard sizes were adopted in order to minimize cutting and sorting, and an ample reserve of materials was maintained well in advance of progress on the ship. She was brought to the launching stage in four months and eight days, and completed for sea eleven months later, a truly wonderful performance. The *Dreadnought* proved to be a splendid sea boat, thanks to

her lofty freeboard—28 feet at the bow—the pronounced flare of the forecastle, and the almost rectangular section amidships, which operated to check rolling. Mr. Narbeth has told us how one morning the *Hibernia*, going out for gun trials, passed the *Dreadnought*, "and it was with great surprise that we read in the newspapers the next day that the weather was too much for the Hibernia to attempt her trials. In the *Dreadnought* the weather had not been noticed." As her main armament the ship had ten 12-inch 45 caliber guns in twin barbettes, three on the center line and two on the beam, giving her a broadside discharge of eight guns. This arrangement was duplicated in six later ships, and was only departed from in the *Neptunes*, where the wing turrets were placed in echelon and the fourth turret was raised to fire over the fifth. In the next class, *Orions*, a purely center line distribution of the turrets was adopted. One of the few conspicuous defects of the *Dreadnought* was her lack of a secondary armament. She mounted nothing between 12-inch and 12-pounder guns. Her successors had a 4-inch intermediate battery, but even it did not satisfy requirements, and eventually the well-tried 6-inch gun was restored. Irrespective of her powerful main armament, the *Dreadnought* was unequalled in the quality of speed. At the date of her completion battleship speeds varied from 18 to 19 knots; but she had been designed for 21 knots, and on trial she attained 21.6. Contrary to what is often affirmed, she was not the first turbine-driven battleship, for that system of propulsion was first installed in the Japanese vessel *Aki*, which was laid down seven months before the British ship. The *Dreadnought*, however, was matchless in her combination of heavy armament and high mobility on a displacement of 17,900 tons, which was only 1,150 tons more than that of the *King Edward VII*, a ship of moderate gun-power and 18½ knots speed. As Mr. Narbeth has remarked, "Critics and writers vied with each other in endeavoring to discover what had been sacrificed to carry this immense armament at the great speed of 21½ knots. It did not, however, appear to have occurred to any of them that the skill of the naval architect and the marine engineer had a great deal to do with it."

As a technical achievement the design and construction of the *Dreadnought* stands unrivalled in the annals of modern shipbuilding. Whether it was sound policy to spring such a surprise on the naval world is another question. As we have seen, the ultimate effect was to depreciate the relative strength of the British Navy. Nor can it be denied that the launch of the *Dreadnought* inaugurated that fierce competition in tons and guns which in the course of a decade had more than doubled the size of capital ships and increased their cost fourfold. Even without the Washington Treaty exigencies of national finance must, sooner or later, have imposed a check on the building of ships at £7,000,000 apiece. It is possible, therefore, that the building of the *Dreadnought* may prove to have antedated by many years the demise of the capital ship, a result which her creators cannot have foreseen.

Great Britain's Air Force

By Walter Millis, *New York Herald Tribune*, 6 February, 1926.—London.—In the United States by this time the independent air force has doubtless sunk to the level of an academic issue. But with the British, who have an independent air force, it unfortunately can never be an academic issue. The first nation in the world to trust itself to a "first-line" aerial defense has, it is true, ceased to argue the principle, but that is partly because it is engrossed in arguing the facts which have ensued upon its adoption. The Royal Air Force, which has been caustically described as "the prettiest infantry in the world," is in existence and is costing money. It has not, as the labors of the Colwyn committee recently appointed to study reductions in the estimates for the fighting services have indicated, either guaranteed

the safety of the British Isles or tended materially to reduce the general burden of the national defense.

Economy tries the souls of bureaucracies, and the latest of the long succession of desperate attempts to limit the British taxpayer's load is likely to result in some interesting trials of the two older bureaucracies and the one very junior bureaucracy, which are intrusted with the national defense. The Colwyn committee was appointed by a government which, ever since its signal defeat last year at the hands of the admirals over the cruiser program, has been suffering under the charge that while it will starve education, unemployment relief and almost everything else, it will not cease to squander upon those services which the Locarno spirit was supposed to have reduced in importance.

"Mr. Churchill," and this is a typical opposition argument taken from *The Star*, "faced by threats of Admiralty resignations, has watered down his economy proposals to negligible proportions, and the Admiralty has gone on with a program of lavish spending, which more statesman-like critics have condemned as a sheer waste of money." The creation of the air force did not succeed in diminishing either the demands of the navy or its power in the councils at Whitehall, and the best that the Colwyn committee, between the admirals, the generals, the air marshals, and the taxpayers, has apparently been able to do has been to try to cut equally all around, and to try at least to prevent the estimates for all three services from going beyond the $600,000,000 at which they now stand.

The air force has been quick to protest that this means a disproportionately heavy cut in the aerial arm, because it is being developed upon a program of steady expansion. It was decided in 1922 that there should be a home defense force of fifty-two squadrons, to be built up by 1930. There are now only twenty home defense squadrons; the expansion program would call in normal course for an increase in the estimates of about 30 per cent, and it is feared that if the Colwyn committee's economies are adopted there will be practically no orders at all for new machines. That will mean not only the collapse of the "minimum" program, but a possible collapse of the aircraft production industry, and it is said that the government has already hinted to several of the weaker firms that they had better cast about for new sources of income. This argument for appropriations is familiar to Americans, though when one expert adds that "meanwhile the aircraft factories of France, the United States and Italy will not be idle," one realizes that it is an argument which has local variations.

As a matter of fact, the Italian factories have not been idle, according to figures published here, which show that the Italians, who in 1922 had only 288 planes and dirigibles, have now built their force up to 2,200 air craft of all types. The French have 1,500 service planes and 4,000 in reserve. The British have 232 first line planes in their twenty home defense squadrons; they have about the same number assigned to the navy and to direct cooperation with the army, and they have, at least for the defense squadron, a 100 per cent war reserve. Besides these, there are eighteen and a half squadrons in Irak, Palestine, India, Aden, and Malta, and small air forces in some of the dominions but what the British wish to see guaranteed is the safety of London against air raids from the Continent, and it is upon that situation that they base their calculations.

The difficulty is, of course, that the creation of the independent air force, while it has decorated London with new blue-gray uniforms in addition to the older varieties, has failed to simplify the problem of apportioning defense appropriations. The navy continues to demand warships, and claims besides that the air force is not giving it enough planes. According to American standards, they are right, for the fleet has only about one hundred planes altogether. In a recent article Lieutenant Commander Kenworthy accepted a still lower figure, putting the total at only fifty-four. The army, of course, in any affair of this sort is likely to come out last, but the air

force does not render the army unnecessary, and since the army does not think that the number of its units can be reduced, there is only the unsatisfactory expedient of cutting down still more the strength of the individual units. The result will probably be the familiar one that the cuts will not satisfy the public and that when they have been effected each of the three services will consider itself too weak for performing its functions. Perhaps each of them will be.

But there is still another side to the air force question. Commander Kenworthy's recent article in *The Outlook*, following a similar attack by Sir Frederick Sykes, has expressed a frequent criticism. The air force considers that it is being starved, but it is already spending $80,000,000 a year, much more than the French are spending, in spite of the fact that it is getting only about one-third as many planes. "Broadly speaking, the reason is that the air force is the youngest of the fighting services and is threatened with absorption by the army and navy; as a means of defense the Air Ministry is consolidating its position by digging itself in. It has established a vested interest in land, buildings, hospitals, churches, schools, swimming baths . . . . and all the other paraphernalia of a separate force. . . . . For every airplane ready for service nearly fifty officials sit in swivel chairs at Adastral House or in the new office in Whitehall." A battalion of airmen are given marching drill as if they were a battalion of the Foot Guards, with bands and ceremonials and all the other military decoration. Mr. Kenworthy, in other words, agrees with the remark already quoted that the air force makes very good infantry. "All this is grand and magnificent, but it is not aviation." The remedy, in his opinion, is to free the air force of any fear of reabsorption in the older services by creating a ministry of national defense.

That might be a remedy, but the argument only tends to support the impression that the new problems of defense, even when they are presented, as they are here, in the direct form of a nation immediately exposed to short-range aerial attack and compact enough for aerial defense, have by no means been solved by the appearance of the third service.

Engineering in America and Great Britain

The Engineer, 29 January, 1926.—It is never safe to assume that what is best in one country will be best in another. No two nations are alike. Their geographical position on the globe, the different climates they must enjoy or endure, the topography of the lands they inhabit, the long history of the races from which they are sprung, all build up characteristics which differentiate the peoples of the world, and give them that temperament which is generally called the genius of the people. Moreover, every nation is the plaything of traditions and the victim of its antecedents. It cannot change at will from one order of life to another, it cannot overcome the inertia of masses which have been accustomed to move for centuries in certain paths, nor can it brush aside the forces of vested interests. Observers may go from one country to another, and admiring the merits of one desire to see them engrafted upon another, but their desire will remain ungratified. The forces that brought about the character and practices of the first are different from those which moulded the second. We may say without great hesitation that if the same influences were at work throughout the world, and had always been at work, then all the peoples on the globe would have the same racial characteristics, and it would be easy for Great Britain or France or Russia to do just what Germany or America, or China, Japan or Czecho-Slovakia did. But the world is not built that way. There are national differences, which, if they can ever be overcome, can only be brought to similarity by intercourse extending over many centuries and by the continuous pressure of forces greater than those which moulded the race into its existing form.

These general observations are prompted by the reading of a pamphlet by Mr. Bertram Austin and Mr. W. Francis Lloyd, which has been recently privately circulated and has received a good deal of public attention. The authors are two young men who resolved to make, at their own expense, a tour of inspection of the United States. They were impressed with what they saw, contrasted it with what they knew of their own country, and were so profoundly convinced of the superiority of the American methods that they wrote down their critical reflections. "After a careful examination of the general conditions obtaining in the country, we have come to the conclusion," they say, "that the present prosperity can be traced to the adoption of, *and strict adherence to*, a few cardinal principles in the *management* of industrial enterprises." Those principles, they add, are due to Mr. Henry Ford. They are nine in number, and might be briefly described as the fundamental principles of *mass* production. The first is an expression of the doctrine of "small profits and quick returns"; the second asserts that there is no limit to productive capacity *per capita* if the proper appliances are available; the third tells us that "rapidity of turnover makes for smaller capital requirements," and will not be accepted without qualification by those who have had to face the initial expense of mass production methods; the fourth advocates the extension of payment by results, and expresses the common truth that high wages are not uneconomical, if the cost per piece is low; the fifth touches upon the importance of welfare; the sixth calls for a free exchange of ideas between competing firms; the seventh is devoted to promotion by merit; the eighth to the value of research and experimental work; and the last to the elimination of waste. There is, we imagine, not a single engineer in this country who has given attention to the economics of industry to whom these principles are not familiar. But Messrs. Austin and Lloyd will no doubt say that whilst we admit the correctness of these principles we do not practice all of them. That is true in part. But we might ask them if all the engineering firms in America practice them either? The fact is, as we have pointed out, that the principles are applicable in the main only to industries which are suitable for mass production and are not applicable as a whole to other industries. Small profits and quick returns is a fine motto for the builder of sewing machines and bicycles—and is regularly employed for such things in this country as much as in America—but it cannot be applied to the building of ships, the making of locomotives, the construction of large machine tools, and so on. Given an industry that permits of the adoption of mass production methods, then high rates of pay can be paid because means are at hand for reducing, by mechanical means, the cost per piece. But when things have to be made by the unit instead of manufactured by the million, the conditions change completely. The authors found in America that the inducement of high piecework wages was sufficient to produce very rapid output, and they have, we gather, assumed that the same inducement would have the same effect here. In that, we believe, they are mistaken. It may be possible here and there for a firm to defy the control of the trades unions, but it must be accepted as a common experience that piecework is not popular in British engineering works. The authors will say that the dislike to it is due to the practice of cutting the rates. We admit that that is always advanced as one of the reasons, but we are far from certain that it is the most influential. The lure of money is not so effective with British mechanics as it is with that heterogeneous class which follows the same callings in America. The question as to what wages men should be allowed to earn is an extremely complex one. It cannot be discussed briefly, but this at least may be said, that, however much the cost per piece may be lowered by quick output for high wages, it would be still less with quick output and lower wages. There is surely an economic relationship between the amount of the wages and the selling cost, and we find it difficult to subscribe to the opinion of the authors that wages may be allowed to ascend to any level, though we agree that, as they say,

"It is to the advantage of the community that the policy of industrial management should be directed towards raising wages and reducing prices." Of the four remaining cardinal principles laid down by the authors it is unnecessary to say much. The principles of welfare are as well understood in this country as in America. The free exchange of ideas has always been inculcated, but we think Messrs. Austin and Lloyd were a little misled if they came away with the impression that it prevails generally to a greater extent there than here. We have not found American manufacturers any more anxious to give away essential facts than their British cousins. As far as mechanical engineering is concerned, the days of the trade secret have gone or are going in both countries.

It is always of service when fresh minds are turned upon an old investigation, and although Messrs. Austin and Lloyd may have brought back from America no new truths, we are grateful to them for having expressed the old truths with the energy and assurance of young men. They have entitled their report "American Prosperity," and we are quite willing to accept the principles they have enunciated as amongst the causes that have led to that prosperity. Where they are likely to have fallen into an error is in assuming, which they seem to do, that what can be done in America can be done here, and that it would have the same effect. Many American firms have come to England full of American ideas. As we know, they have only succeeded very partially in engrafting them upon British practice. Yet since they have stopped in our midst we may assume that they have found the British way not so hopelessly bad, after all. The most serious mistake made by the authors is in taking it for granted that the British workman and the American workman are alike, and that what will appeal to one will appeal to the other. The British workman is one nation, the American workman is a conglomeration of nations. The American units are out more for themselves than they are in Great Britain, where the trades unions have succeeded in establishing a cohesion and in many instances a true brotherhood which submerges the individual in the mass. As to the merits of that result there may be differences of opinion, but it must be accepted as a living fact which no economic desideratum can overthrow. Our authors have written at a moment when Great Britain is under an industrial cloud, and America in the sunshine. We hope that before many months have passed they will be able to find that the principles which guide the engineering industries of this country are not hopelessly defective, and that under them we can hold an even place with the United States of America.

FRANCE

French Navy Notes

The Naval and Military Record, 27 January, 1926.—Parliamentary vacations have been made good use of by the Ministry of Marine. A new recruiting law is being prepared that will give to the navy a majority of long-service men; orders have been awarded for new submarines and new so-called torpilleurs d'escadre (1,500 tons, 107 meters long, 10 wide, 35,000 h.p., and 33 knots); torpedo and aerial units on new lines are to be studied; and colonial defense to be at last looked after. Tactical training and sea practice are taking place both in the North and in the Mediterranean; coastal defenses are being tested, and the use of smoke-screens studied. The able Admiral Dumesnil has been anew appointed "Inspecteur-General des Forces Maritimes du Sud" for 1926.

I had the privilege of visiting *en détail* the fine destroyers of the *Warwick-Versatile* class during their recent and welcomed sojourn in Brittany waters. They attracted popular attention, received thousands of visitors, were much admired, and made the best impression by their elegant and imposing appearance, being termed *les petits croiseurs Anglais*, and by the

remarkable cleanliness and order, and the obvious spirit of cheerful discipline that prevails on board. Receptions, banquets, *vins d'honneur*, theatrical and cinema free representations, football matches, and private entertainments marked the Breton-British fraternization, with plenty of hearty public talk of mutual goodwill and appreciation. The fraternity of arms of the Great War was being revived in words and sentiments, and the opinion was freely expressed that a return to the closer Franco-British bonds of the war is the right solution to the colonial and economic difficulties confronting our two great countries. Besides, Brittany is a land of seamen where "brotherhood of the sea" is not a vain expression; and in Breton towns and streets there was evidence that British seamen felt very much at home. Jack Tar had a good time, all the more so as the crossing from Portland, marked by maneuvering in rough weather, had proved rather trying and made a rest on shore all the more welcome. It was noticed that the number of English officers speaking French fluently was relatively great, which is a result of the acquaintance British seamen made with France during the war.

French *officiers de vaisseau* and *ingénieurs*, of course, gave a curious and sympathetic look to the British 1,300-ton destroyers, that were compared with the new French destroyers of the *Simoun* class, which are in reality, and in all essentials, enlarged copies of the English *V* class. The French boats, of course, are larger by 200 tons, and more powerful, carrying bigger guns and torpedoes. The four guns of the *Simouns* are of 5.1-inch bore, and fire shells of 27 and 33 kilos (with caps), thus being twice as heavy as British 4-inch projectiles. Similarly, French torpedoes are 22 inches in diameter and nearly two tons in weight, and they are six in number, whereas British *Versatiles* only carry five torpedo tubes of 18- or 21-inch diameter.

Still, the British 1,300-ton type of destroyer has found warm partisans among our experts. A noted constructor observed: "Those English *Warwicks* and *Vancouvers*, in my opinion, are the most perfect type of *torpilleurs de haute mer* in existence. Size is not everything, and has drawbacks in torpedo warfare. The most efficient warship is not the largest and the most heavily loaded, but it is the one best fitted to the sort of warfare it is intended for, and in which every part of the design has been calculated towards a military end. Destroyers have two main jobs waiting for them: duels with hostile destroyers and action against enemy squadrons. Well, I would bet on the *Warwick*. She is not so deep in the water as our *Simouns*, and is likely to be more handy in maneuvering, which is of some moment in torpedo tactics. She is also not quite so high on the water, not so top-heavy; therefore she is less vulnerable and more steady. Her guns, of course, are relatively weak, and cannot compete for range with our 130-millimeter weapons, but they can fire twice as quick, and, besides, belong to an improved and thoroughly reliable model (4-inch), whereas our new French cannon are more or less experimental. Considering the design *dans son ensemble*, the British 1,300-tonners represent higher military value than our 1,500-tonners. That can be seen from a superficial examination and comparison of decks. In British boats, fighting is the *raison d'être* of all deck installations. In French, *cuisines, buanderies, lavabos*, and what not are encumbering the place, making one think of old Marshal Soubise, who went warring against Prussia with 100 cooks! *cent cuisiniers.*"

The superiority of the *Simoun* type was defended by an *officier de vaisseau* with the following arguments: Range and sea-keeping capacity make up the power for mischief of warships in the light of war experience. Those points are very much in favor of the *22 Simouns* of 1,500 tons (12 afloat, 6 ready to be launched, 4 just ordered) that outclass the 64 British boats of 1,300 tons, though excellent they be. As to the superior military utilization of the *Warwicks*, these boats were designed and constructed during the war at a moment when objects were limited and when to do things quick was the chief consideration. Their constructors had no

time but to look after essentials, and had to neglect comfort and details of no military moment. The *Simouns,* on the contrary, embody the lessons of the war in every respect; they are stronger at every point than their British rivals and offer cruiser comforts in their crew quarters and cooking installations. Motor-power (three boilers and two turbines) occupies in them less space than in the British boats, that are shorter by nine meters and narrower by two feet. Another interesting point is worth noting. Owing to the peculiar shape of their bows, the *Simouns,* when steaming at high speed, rise up forward by some nine feet, as if flying and supported by the air; hence complete stability, gain in the command of the guns, facilities for accurate shooting, and also facilities for the ship making headway against heavy seas. The *Simouns,* like the *Chacals* of 2,400 tons, mark a French advance on the world.

With a view to favoring the recruiting and re-enlisting of matelots of good class, Minister Leygues is doing his utmost to improve still the conditions of comfort on board our *navires de guerre,* though enormous progress has been made in that direction since the war. No longer improvised cooks, but *cuisiniers de métier,* are henceforth to attend to the stomachic needs of our brave matelots with a view to enabling them to fight on well-filled stomachs (as Englishmen are traitionally fond of doing). So far so good, but in truth it is doubtful if such material improvements will influence recruiting in the manner expected, at least so long as religious or patriotic teachings of any sort are systematically banished from our school and from the navy itself. Something higher than a desire for good meals is needed to induce men of the right sort to devote their lives to the navy.

The 2,400-ton *Tiger,* the first of the new series of super-destroyers (*éclaireurs légers* in reality), has left Lorient for Toulon, where a few months hence her sister ships *Jaguar* and *Panthère* will join her. Exhaustive gun, torpedo, and motor trials at sea proved satisfactory beyond expectations. She maintained for hours in choppy waters 37 knots, with a fuel consumption below that stipulated for 35.5 knots, and her enthusiastic engine staff are boasting she could do more if required. Her Rateau turbines developed 60,000 h.p. At full speed, with her bows raised, she proved a steady gun platform, with cruiser command of fire. Her 130-millimeter weapons are good for seven rounds per minute. The center gun is not, however, so favorably placed regarding ammunition supply; still, in Italian *Leones* (8 guns of 120 millimeters) the situation in that respect is not quite so good as in the French. Moreover, Gallic cannoniers with war experience consider quick-firing in action as being impracticable in practice. To fire accurately and to secure the first smashing hits is a matter of great moment; and that the *Tiger* will be able to do. Her guns are as powerful, with their 15,000-yard range, as the 6-inch of the British *Sydney,* that sank the *Emden* at Coco Islands. Superiority in range is what France is aiming at for her flotilla units. Speed supremacy may also possibly be hers. Her new 2,400- and 1,500-ton units mark a new move in naval architecture. The novel shape of their hull favors speed, especially at full-power; and, besides, propeller problems are being closely studied by French experts and wonderful progress is recorded.

The Manufacture of Armor Plate

The Engineer, 12 February, 1926.—On January 15, M. Baclé delivered his presidential address to the Société des Ingénieurs Civils de France. He took as his subject the manufacture of armor plate, and in what follows we endeavor to give some idea of the principal points in his address.

The president observed first that although the armoring of ships might be regarded as characterizing warship construction during the past fifty years, yet its origin could be found much further back. He noted that the

Carthaginians, according to Strabo, armored their wooden vessels, that in the twelfth century naval powers, the Normans, for example, protected certain types of ships, and that the Knights of St. John of Jerusalem employed armored caracks—for the siege of Tunis—as did the Venetians in the sixteenth century. In 1780 the Chevalier d'Arçon protected floating batteries which were employed for the siege of Gibraltar with bars of iron. But these early devices might be regarded as of an exceptional and makeshift order, and the arming of ships destined to make ocean voyages would never have been considered had not the progress of gunnery in the first half of the nineteenth century made it essential. It was the invention by General Paixhans of the explosive shell which burst on contact, that finally settled the question and opened the ironside era. The *La Gloire* was laid down in 1858, and was followed shortly afterwards by the *Couronne,* which was the first frigate built of iron and provided with metallic armor plate. The example set by France was followed by England, and a national contest ensued in the development of armor. In 1861 the *La Flander* was given a belt 15 centimeters thick at the water line. Four years later ships of the *Ocean* class had a belt 20 centimeters thick, in 1872 the *Devastation* was given 38 centimeters, and finally, in 1881, the enormous thickness of 55 centimeters was reached in the *Amiral-Duperré.* That figure has never since been passed and is the last example of the use of iron for armor plate.

With the coming of this great thickness, it was recognized that the limits had been reached, and that since it was impossible to increase the thickness further, means must be found for producing a harder metal. Steel was already in use for many purposes, and even as far back as 1873, attempts had been made to employ it for ship's armor but without much success. However, Creusot persisted in the experiment, and after many years of endeavor, succeeded in producing a sucessful plate. While that firm was engaged in making armor by the forging of huge masses of steel, the two great Sheffield firms, Cammell's and John Brown's, took up the manufacture of compound armor in which the steel was cast directly on to a backing of iron, the compound metal being then heavily rolled. In 1880 comparative tests were carried out by the French Navy at Gavres on six plates made by different methods, one welded plate by Marrel Brothers, two cast steel plates by Terrenoire, two forged steel plates, one of soft and the other of hard metal, by Creusot, and a compound plate by Cammell's. These tests proved conclusively the superiority of the Creusot and Cammell plates which, although they broke up under the impact of cast iron projectiles, were not, as were the other plates, perforated by them. The navy, therefore, decided to adopt plates of these kinds, one being made by Creusot and the compound plates by St. Chamond, Marrel, and Châtillon, who acquired licenses from Cammell's.

From 1882 until 1891, the navy accepted either kind of plate indifferently, and the acceptance trials revealed their characteristics. The Creusot plates, regarded from the point of view of comparative resistance, showed a slight superiority over the Cammell plates, but they were unable to break up the projectiles, as the compound plates did when well made, but both kinds of plates broke frequently when submitted to the attack of three projectiles, especially when cast iron shots were replaced by cast steel and later by forged steel shots. Trials carried out between 1884 and 1889 showed conclusively that some new method must be devised in order to overcome this brittleness. As soon as this fact was established steel masters set about the discovery of a metal free from that serious defect.

The qualities demanded were great hardness of the face with malleability of the back—so that the plates might be bent to shape—great resistance to penetration, perfect homogeneity of the entire mass, and absolute freedom from all interior defects. The history of the armor plate industry is to be found in the continuous search for these qualities. In England, John Brown and Company adopted the Tresidder process of hardening the surface of

compound plates, while in France the manufacture of steel plates by forging was generally taken up after 1890, when tests carried out at Annapolis showed that Creusot plates made of nickle steel were less brittle and more resistant than plates of ordinary steel. A steel having 2 to 3 per cent of nickel with some chromium, was produced under the name of "special steel," and was rapidly adopted with minor modifications throughout France, as well as in other countries, as it exhibited a resistance to perforation 12 per cent greater than that of ordinary steel, and 34 per cent greater than that of iron; but as it was found almost impossible to manufacture these nickel chrome plates in considerable thickness, they were reserved only for positions where thin plates were sufficient, while for heavy plates, steel with a small amount of chromium was used, but cementation of the surface was carried out with a view to breaking the projectiles on impact.

The cementation process was invented by Harvey, and was first tried in America in 1891 at Annapolis and Indian Head. Between 1892 and 1897 Harvey's cemented plates competed in several trials with "special steel" plates. It showed remarkable qualities of resistance and a hardness which broke up the projectiles, but at the same time it was more brittle than the "special steel." The French manufacturers decided therefore to take up the Harvey process and to combine it with the employment of "special steel," and they succeeded thereby in producing plates with a low brittleness and with a perforation figure 25 per cent greater than that of ordinary steel. Plates of this kind remained in use until 1900, but the arrival of forged chrome nickel shells, which were able to pierce the plates without being broken or deformed obliged armor-plate makers to seek for still further improvement. In 1896, Krupp's had produced a cemented plate containing 3.5 per cent of nickel, about 4 per cent of carbon and 2 per cent of chromium. It was made free from brittleness by careful heat treatment, which produced a hard face at the same time that it left the desirable soft backing. In this process differential heat treatment was used, the front part being raised to 800 degrees, Centigrade, sufficient to allow of hardening by rapid cooling, while the back parts of the plate were only raised to 400 degrees Centigrade. In spite of the difficulties that this process presented, it was rapidly adopted by the armor plate firms all over the world with one exception. The works at Rive de Gier developed and produced in 1905 a special process invented by their late director, Monsieur Jules Marrel. In this process a 4.5 per cent nickel steel, with .25 per cent carbon and .60 per cent chromium, was employed. The steel, although less hard than that of Krupp, had the desirable qualities, a porcelain like grain in front and a fibrous texture behind, and the difficult differential heat treatment of Krupp was not required. At trials carried out at Bethlehem in 1913, the Rive de Gier method was proved to be so successful that Ansaldo Brothers decided to adopt it for armor plates for the Italian Navy.

While continuing with the use of the Krupp process French engineers pursued their investigations in a scientific spirit. Among them must be mentioned Monsieur Charpy, who discovered in 1902 a new type of special steel which achieved remarkable results. It contained 0.10 per cent of carbon, 5.5 per cent of nickel, and an amount of chromium which varied according to circumstances between 0.6 and 2 per cent. This steel showed a high resistance to perforation with freedom from brittleness. Creusot on its side examined the use of molybdenum, and at the Paris Exhibition of 1900 showed a plate with the chromium content as high as from 3 to 4 per cent, which proved to be as good as, if not better than, Krupp's cemented plate. But the capped projectile then appeared and introduced a new element into the never-ending conflict between the projectile and the armor plate. As it reduced the efficiency of cementation, it seemed to indicate that the desirable steel would be a homogenous metal, not cemented, yet as hard as the cemented plates. The war of 1914 came to stop these researches, and in France, at all events, they have not yet been taken up again.

To outline the progress in a few words: if we consider a plate of 200 millimeters thickness attacked by a gun of 194 millimeter caliber, we see that quite a large plate gave a speed of perforation of 385 meters, which was raised to 471 meters when iron was replaced by ordinary steel. With "special steel" the speed rose to 528 meters, corresponding to a plate of 360 millimeters thickness, that is to say, increased the resistance by 65 per cent. When this metal was cemented the speed of perforation was raised to 612 meters, giving a coefficient of 1.60 with respect to iron, and of 1.30 with respect to ordinary steel. With still more recent steels with a thickness of 280 millimeters, the speed of perforation, with uncapped projectiles, attained about 700 meters, that is to say, a plate of iron offering the same resistance would have to be 512 millimeters thick.

In the continued search for improved steels for armour plate, great factories have converted themselves practically into laboratories, where the work was carried out with that strictness and exactitude which was so well shown by Monsieur Charpy in the St. Jacques workshop at Montluçon. These studies had useful results in many other directions, and are reflected in the development of steels for railways, marine engines, electrical apparatus of all sorts, automobiles, and even for the flying machine. It should never be forgotten when we watch the wonderful developments of engineering of recent years, that it is due in no small measure to the scientific researches which were carried out originally on the production of war material.

French Now Argue Sale of Colonies

By Georges Lechartier, *Baltimore Sun*, 2 February, 1926.—The dispatch stating that the French Ambassador, M. Henry Berenger, resumed on his arrival in Washington the parleys which were somewhat abruptly interrupted when M. Caillaux left the capital in October last has for the time being silenced here the noise of local interests' and politicians' conflicts, which confused lately all international decisions, and even those that may later influence profoundly our internal politics.

The public attention is once more focused on the eventful settlement of our debt. While the instructions given our Ambassador by the government are yet unknown, the press and the public here are debating the conditions that may be offered by the American commission, and the suggestions that shall be presented by our official envoy.

Once more the question of the sale of some French colonies to the United States—wholly disregarding the desire of the United States to acquire them—as a means for the repayment of our debt and the improvement of our finances is now seriously considered and will probably once more be echoed in the Parliament.

The supporters of the scheme, among whom the well-known writer, M. Claude Farrere, seems to be the firmest, point out that the actual administration of the French West Indies, abandoned to the native negroes, makes these colonies of but small profit, while they are almost uninhabitable for white men. And they insist that the sale of Martinique and Guadeloupe would be the only rational way of repaying our foreign debts without placing a new burden upon the shoulders of the already overloaded French taxpayer.

It is unlikely, though, that these views will be upheld by the government for some time to come. The problem has not been officially presented, but during the debate in the House on the colonial budget in the latter part of December the Secretary of Colonies, M. Leon Perrier, speaking for the government, stated:

"The press has been recently conducting a campaign which it is most necessary to stop. It is said that the sale of one or several colonies is actu-

ally envisaged in official circles as the best means for solving the financial difficulties in which France is now slowly being engulfed.

"Never, at any time, under any circumstance, was such an eventuality considered and still less discussed. Never, however difficult be the financial conditions which we shall have to face, will such a possibility be admitted by this government."

And M. Herriot, answering a few moments later a question of the black representative of the Guadeloupe, emphasized the statement of the Secretary of the Colonies and declared just as grandiloquently: "The colonies are the daughters of France. A mother does not sell her own children."

Which, of course, did not mean anything, but was frantically applauded, as "hot air" usually is when properly introduced in any political assembly in the world.

The fact is that there are colonies—those in Northern and Middle Africa—which France cannot sell, because they are absolutely essential to the life of the nation. Besides that, she brought to them the methods of cultivating and mining which have considerably developed their natural richness. France has decisively helped them to rid themselves of the banditism and of the savage razzias which continually imperiled the life and properties of the small tribes. France has really established permanent peace where a state of war—of the most merciless sort—was rampant. On the other hand, France has become the natural market for their produce of all kinds. The selling of these colonies, namely, of Algeria, Tunisia, Congo and Madagascar, cannot be a question.

But besides these colonies, which are now considered and have really become with time integral parts of the nation's life, there are others which are not so intimately nor so morally bound to France and which she could sell if she could find such advantage in the transaction as to avoid a grave economic crisis at home or even a financial failure.

To this second class belongs the great colony of the Far East, Indo-China. It must be immediately acknowledged that the scheme for selling this colony, or at least part of it, finds but few supporters here. It is observed that the progress of this oversea possession, which progress Lord Northcliffe wonderfully emphasized a few weeks before he died, eulogizing the cleverness, humanity and efficiency of the French administration, is such that to abandon it now would be equivalent to renunciation by France of her mission of civilization.

Moreover, the richness which it now produces is indispensable for balancing her budget. The supporters of the selling scheme, who declare that it is just as good to part with the colony while it is at its climax of production, instead of waiting for some great power of the Far East to take it over most easily when France will have no navy or army to protect it, are very few and certainly not powerful enough to make the Parliament change its mind about the question.

As to the sale of the West Indies there are two divergent opinions among the public and more in the Parliament.

The reason why France should sell her Caribbean and possibly her Pacific islands to the United States—provided that the United States be willing to buy them—are (besides those above indicated) that the French West Indies are, as their geographical situation shows, merely detached from the American continent. They obviously belong to it. Rightly or wrongly it is believed here that the United States, without finding the same interest in the bargain as it did when buying Louisiana in 1803, would gather from these islands an appreciable and much greater profit in coffee, sugar, cotton, saying nothing of rum, than France ever did under the native Negro administration.

The same thing could be said about Tahiti and the French possessions in the Pacific. The United States has already many well-established firms there which control, if they do not monopolize, the most important trade in

pearls, vanilla, and copal. Moreover, the American missionaries have several important and prosperous settlements and schools in these islands. Under these circumstances it seems that it would be as easy and profitable to France to part with colonies which are already wholly Americanized as it would be to the United States to purchase them.

In both cases wisdom as well as interest advocates the sale. However, the voice of wisdom is but rarely listened to in an ordinary assembly of politicians and never when parties' interests are raging. This is unfortunately the present case in the French Parliament concerning the eventual sale of both groups of colonies.

While the former and present Premiers, the Secretary of the Colonies, and a majority of radical Deputies join with the Communists in proclaiming that the Negroes of Martinique and Guadeloupe are French citizens since the year 1848, while they insist upon recalling the sentence of President Wilson that "peoples and provinces are not to be bartered about from sovereignty to sovereignty as if they were mere chattels and pawns in a game," while they speak about the "mother who does not sell her daughters," the simple truth is that these black "French" citizens from Guadeloupe and Martinique are voters.

And they send—usually after the most unheard of electoral scandals—black representatives, invariably Radicals and Radical Socialist, to the Parliament in Paris. The support of these representatives proves, at time of crisis, most helpful to the majority of the government.

If this government actually resists the pressure of the best-informed French opinion, if it still refuses to admit that the parting with two useless and not overdevoted colonies is probably the best and most practical means for getting out from a now almost inextricable financial situation, if it appeals to vague or false sentiment when interests and figures only are concerned, the reason is in politics and nowhere else. It is a question of majority and votes.

Urges the Transfer of French Colonies

By Captain Dudley W. Knox, U. S. N., Retired, *Baltimore Sun*, 12 February, 1926.—The resumption of French debt negotiations in Washington has revived discussion in Paris of possible part payment by the transfer of certain of the French colonies to the United States, according to the article by M. Georges Lechartier published in *The Sun* on February 2. This matter has received spasmodic attention in the French and American press for several years, but never seems to have been given serious public consideration in either country.

Sentimental reasons suffice to account for French apathy on the subject. In America the reaction appears to be that we do not want any more colonial possessions; least of all a number of small islands which are likely to prove a financial liability and hence a poor reimbursement for loans made by us in hard cash. Such an American view was rational and understandable before France's incapacity to pay in full was so apparent as now, and before the precedent of the Italian settlement, whereby incapacity to pay was accepted as sufficient justification for a cancellation of a large proportion of the total debt.

But now we are clearly confronted with the likelihood of having to accept from France perhaps a billion dollars less than we actually lent to her. If ordinary rates of interest should be included in the French debt this deficiency will probably run into several billions. Should we be content with such a huge reduction and should France be willing to ask it, when France is perfectly able to cover the equivalent of the gold deficiency by transferring to us insular territories of very little value to her, but of great strategic importance to the United States?

American public interest in this question would be less apathetic if it were better understood in this country how greatly our position in the Pacific would be strengthened by the acquisition of that extensive group of French islands which includes Tahiti and the Marquesas.

Their possession would give us a new route to the Philippine Islands of great value in the event of our having to go to the rescue of our Filipino wards against the aggression of Japan or other Far Eastern power. Such a southerly route has assumed large importance ever since the events of the World War, which resulted in giving to Japan the very extensive Marshall and Caroline Islands, formerly German, lying squarely across the path of our fleet in a passage from Hawaii to the Philippines.

The elements of this strategic situation in the Pacific are very simple, and easily understood by a baseball public, since the crucial positions resemble a great diamond; the home plate being represented by the Panama Canal, and second base by the Philippine Islands.

The main sources of American strength cluster about the Atlantic seaboard and are best and most quickly projected to the Philippines through Panama. From here, at the home plate, the fleet, supply ships and transports could not reach the Philippines, at second base, without stopping en route for refueling and refreshment, and at present would have to proceed via Hawaii, corresponding in position to first base.

But further progress toward second base is barred by difficult obstacles in the form of Japanese occupied islands, furnishing ideal centers for the operations of aircraft, submarines, and other ships. The approach to the Philippines, at second base, would be very much easier if we could go by way of third base, represented on the great diamond by the Marquesas Islands.

The total distance by either route is virtually the same, being slightly less by the southern one, which offers the further advantage of several other stopping points, such as Tahiti and American Samoa. It should be remembered that the big problems of naval strategy include not only the movements and operations of the fleet itself, but also as a cardinal consideration the maintenance of a line of supply.

When such a line is exposed to the easy depredations of an enemy, such as would be our case in using the line Panama-Hawaii-Guam-Philippines, practically all of the fleet's energies would have to be absorbed in protecting the communications against hostile raids, leaving little force to match the opponent's main fleet. On the other hand, a southerly supply line passing through Marquesas and Samoa would be so far removed from hostile raiding centers as to require comparatively little force for its local protection.

Manifestly these Pacific Islands, which are now French, are potentially of great strategic value to the United States. At the same time they are a strategic weakness to France, since they are widely separated from any of her other colonies and do not furnish an essential stepping stone to them from France.

French colonial interest centers around Northern Africa, whence vital supplies of men and stores may have to be drawn for a European war. France also has large interests in Cochin China, which is best protected by a route through the Mediterranean. Her Pacific islands are so detached from her main empire as to be very difficult to protect, and constitute a strategic weakness.

Is it odd that sentimental and economic considerations would also make of these Pacific islands American rather than French possessions. The Marquesas were first discovered by an American. In the old whaling days American ships and seamen greatly predominated over any other foreign visitors there and at Tahiti. Sometimes our whaling ships spent several years at a time in this vicinity.

American missionaries gave to the natives their greatest moral and cultural advance. In 1813 Commodore David Porter hoisted the American flag over the principal island of the Marquesas, naming it Madison Island and designating its principal harbor as Massachusetts Bay. This was his principal base in the operations of his squadron against British commerce in the South Pacific during the War of 1812. Congress, however, did not approve making permanent this American occupation, and subsequently France took possession.

Even today, as M. Lechartier points out, Americans practically monopolize the principal foreign trade of Tahiti, and several important and prosperous American Missionary colonies are established there and maintain schools and churches. He says that the natives are "already wholly Americanized."

There appears to be no economic, sentimental, or strategic reason why these islands should remain in French posession. There are important strategic reasons why they should be under our control. There is every reason why any deficiency in French debt payment to us, on account of French incapacity to pay principal or interest, should be made up by the transfer of these Pacific islands.

The French insular possessions in West Indies would also be of some strategic value to us, principally as centers of aviation, in the protection of the Atlantic approaches to the Panama Canal. But the Pacific islands, including the groups known severally as the Marquesas, Society and Tuamotu, though virtually one group, are immeasurably more important from our viewpoint.

GERMANY

Industrial Conditions in Germany

Engineering, 29 January, 1926.—Before the Armistice, the statement was publicly made that, as engineers had got the world into the war, it was their duty to get it out again. Though this was mere rhetoric, is contained a truth applicable to post-war conditions. The future of commerce with an industrial nation like Germany depends, if we get down to fundamentals, upon the relative energy of the engineers of that country and of ours. Some means of estimating this will be found in one of the recent reports of the department of Overseas Trade, entitled "Report on the Economic and Financial Conditions in Germany," by Mr. J. W. F. Thelwall, M.C., together with a "Report on the Industries of the Occupied Territories," by Mr. C. J. Kavanagh. The authors admit that previously accepted theories of the political economist have been falsified, and that time alone will show what may result from the present position, yet, from the mass of figures and other facts provided some reliable conclusions may be drawn. Curiously enough, the average number of bankruptcies per month is quoted as a cause for optimism, the figure being 811 before the war, 21 in 1923, and 476 in 1924. It is further significant to note that, for the first time in ten years, dividends are appearing in the German share market reports, the average return on the capital of eleven metal and engineering companies to the end of March of this year being 6.01 per cent.

One of the more striking features of German industry is the way in which combinations are being formed, not merely groups of associated trades, but organizations in the vertical direction as, for instance, an ore-mining company, a coal-mining one, a steel works, a shipbuilding yard, main and auxiliary engine works, electrical works, etc., combining to form a more or less self-contained unit. In the horizontal direction, i.e., groups of similar occupations, this tendency is even more marked and international combinations are being formed. Thus, the electric lamp producers of different countries are now working together. A similar organization for coal and steel is being advocated in some quarters, over-production and protection

compelling attention to such possibilities. Other interesting developments may be found in the agreement of the Westinghouse Electric and Manufacturing Company of New York, and the Siemens-Schuckert Company to exchange the results of all investigations, inventions, experiments, and records of working methods for a period of ten years. The Motorenwerke Mannheim have arranged to work with the Bethlehem Steel Corporation, U. S. A., on a fifteen-years' agreement, a money advance by the latter, and the supply of Diesel engines by the former, being two of the conditions. Friedr. Krupp A.G., Essen, have amalgamated with two companies in Jugoslavia and have established a number of interests in Spain. A large combination of engineering firms exists to develop trade with Russia, while a thirty-years' concession for railway, structural, and agricultural supplies for the Turkish Government has been obtained by the Tuerkische Werke. Similar arrangements are being made for such industries as the textile and porcelain trades—in the latter case, for example, a German and a French firm have opened a joint shop in Paris.

The situation as regards coal is a little complicated, for pre-war figures available refer to a country with different frontiers, and those of recent years are involved with reparation deliveries and the occupation of the Ruhr. One fact, however, stands out quite clearly, and that is that Germany will practically cease to be a purchaser of British coal in the future. As is well known, there are in Germany not only large coal fields, but great quantities of lignite. Attention has been directed to the more effective utilization of the latter by the fuel shortage which immediately followed the war. The use of oil both in the furnace and in the internal-combustion engine is, further, being rapidly extended, a significant fact in this connection being that the Norddeutscher Lloyd, which formerly owned coal mines for its own supplies, has recently sold them, the demand from their own ships being now too small to keep the plant going efficiently. It seems possible that the continual experiments being carried out in Germany in the distillation of oil from coal and lignite may result in the development of a commercially-practicable process, which, together with hydro-electric developments, will render Germany independent as regards sources of power. Till this occurs British competition in the coal industry is being fought by various methods. The cost of transport has been steadily reduced, and, in addition, special railway rates were introduced in May, 1924, to bring down is slowly coming into favor again but, even when wages are increased by 25 per cent over the daily rates by its adoption, the German workman receives only about one-half the wages of his British rival.

Again, output is being maintained at a high level, and the coal trade in Germany is regarded as having returned to normal conditions by 1924, in which year the average monthly production of coal was 9.902 million tons, as compared with 11.729 million tons in 1913. The total yearly fuel production, including lignite, was 160.281 million tons in 1924, as against 169.829 million tons in 1913, taking present frontiers. These figures do not differ widely, but more men are employed now than in 1913. The working hours underground are eight per day in Germany, as compared with the British seven, but in the former country ascent and descent are included, so that the real average increase in the time worked per day is about 18 minutes. Up till December, 1924, miners' wages were actually less than in 1914, though the cost of living was higher by 70 to 80 per cent. A slight increase has been made since, but even now the German miner is much poorer than he was before the war.

Imports of British coal have, of course, fallen off considerably since the re-opening of the Ruhr. The figures for 1923 are abnormal and the other post-war figures are affected by various factors, but the average imports of 501 million tons per month during 1924 do not compare well with the 767 million tons pre-war, though the latter figure is for the old frontiers.

In addition to reduced railway rates and maintained output, the mining industry, as well as most of the metallurgical trades, has the advantage of now being equipped with the most modern plant which was put in during the inflation period. It is estimated that generally, the capacity of most works is doubled due to this re-equipment, without any diminution in quality. The labor position appears to be comparatively stabilized. There are no trade union restrictions on output, and the operatives, particularly in the smaller works, attend the maximum number of machines with good results, while the subject of overtime has never become acute. Piece work the cost of coal at the bunkering ports. These concessions amount to as much as a decrease of 30 per cent for delivery at Hamburg independently of the general reduction.

Hydro-electric schemes are consistently receiving attention. In Bavaria, for instance, there are under construction plants representing 50,000 h.p. and schemes are in progress for another 400,000 h.p., which, together with the existing 540,000 h.p., accounts for about half the available water power in that state. Baden has 800,000 h.p. available, and is embarking on distribution plants from stations on the Central Alps to the lignite mines of the lower Rhine. Other states are equally active, and the many schemes include extensive railway electrification.

The shipbuilding industry has shared the depression existing in most other countries. An examination of the balance sheets of the leading firms shows an almost complete disappearance of debentures and mortgages, and serious reductions in materials and ships under construction as compaired with 1913. Yet a working week of 54 hours is maintained on the average, and the skilled workman gets from 35 shillings, 7 pence to 37 shillings, 8 pence per week. Special reduced railway rates have been in force from April, 1925, for the transport of iron and steel and manufactured iron and steel parts for shipbuilding from the steel works to the shipyards. The motor vehicle industry is decidedly backward both as regards design and finish, and has been protected by heavy duties on imported cars which, moreover, are limited to four per month of any make. A heavy duty has also been imposed on motor cycles, but as the German product is stated to be very expensive and of poor quality, the handicap is really less severe, and this market would appear to be one worth attention. The manufacture of aluminium is extending. In 1913 the annual production was about 800 tons, in 1924 it was 20,000 tons, for 1925 a bigger total still is expected.

The iron and steel industry may be said to be in a fairly satisfactory state, and its activity may be gauged by the fact that Germany is using more of these metals than the United Kingdom, even after the extensive refitting of the inflation periods. The home market is being most assiduously cultivated and 80 per cent of the total production is estimated to go in this direction. It is stated that the acceptance of foreign contracts at cut prices is really based upon the desire to reduce overhead charges, thus helping to keep the large units, which are a feature of German iron and steel plants, running at an economical rate. This policy is helped by the formation of various syndicates which operate in this direction by the transfer of orders to works which can then produce up to their full and most economical capacity.

German Battle Fleet Tactics

By Sir Herbert Russell, *The Naval and Military Record*, 10 February, 1926.—The Battle of Jutland, as we all know, was the result of an altogether unrehearsed meeting. So little did Admiral Scheer expect to come upon the grand fleet that his whole purpose, from the moment of sighting the British battlesquadrons, was to get back home as best and as fast as he could. There was, therefore, no premeditated tactical scheme about the action on the German side. In other words Jutland cannot be

regarded as illustrating any preconceived methods by which the German high seas fleet counted upon meeting the British grand fleet with any possible prospect of success. We have been led to believe that some such plan did exist, but thus far, beyond the general knowledge that a state of mutiny in the German Navy put a stop to any attempt to carry it out, no definite details have been disclosed.

Probably, without really meaning it, Admiral von Trotha has now supplied the missing passage of history in this respect. During the course of the inquiry before the Reichstag sub-committee as to the causes of the German downfall in 1918, he told the whole story of how the high seas fleet was to be launched in a final blaze of glory—with the forlorn hope that it might not prove final after all. It is necessary to understand the political situation at the time when this great enterprise was contemplated in order to thoroughly realize the conditions which led up to the abortive revolution. Germany was beaten, her armies being steadily forced back. The Kaiser had taken the supreme administrative power out of military hands and vested it in the civil government, a counsel of despair by which he ceased to figure as the all-highest war lord. But at some period, which, as far as it is possible to determine it, must have been shortly after Jutland, he had given his consent to a project by which Admiral Scheer hoped to wear down British numerical superiority by means of attacks of progressive intensity, in which all available submarine were to take a prominent part, until it appeared feasible to attempt a grand clash.

This permission, the naval command held, was not rescinded by anything the Kaiser said or did subsequently. To put it more plainly, the naval command did not intend that it should be rescinded, and there can be no question that the officers of the German Navy were unanimously prepared to face the alternative of going down fighting rather than surrender. It is characteristic of German mentality that when the military situation had reached such a stage that the violation of the neutrality of Holland by a British expenditionary force would have turned retreat into a rout, they fully expected us to do it, as the obvious thing. The last grand sally of the high seas fleet—which never materialized—was largely designed to head off any such attempt on our part.

The German idea was that a shattering blow at our sea power might render us too apprehensive about our sea communications to undertake such a serious commitment. General von Kuhl has definitely stated that only lack of reserves had prevented the German troops in retreat from invading Holland to dispute the progress of a British expeditionary force which German general headquarters had every reason to believe was about to land to cut the rear of the armies of Prince Rupprecht. What the Germans had done in Belgium they expected us to do in Holland without any hesitation.

The German high seas fleet at this time had become rather "mouldy," but the naval command appear to have had no suspicion as to the real state of demoralization of the lower-deck. A very large proportion of the ships' complements was composed of reservists, and, despite the distorted war news, these knew that Germany was beaten and that nothing they could hope to do was going to avert the inevitable end. This frame of mind, however, was to come as a very disconcerting revelation later on. The naval command was too preoccupied with preparing its battle plans to ever consider the possibility that these would be rendered abortive by mutiny.

Secrecy was of supreme importance, for the enterprise was to be in the nature of a "bolt from the blue." Only twenty senior officers of the German naval staff were permitted to be "in the know," and it is probably owing to this rigid exclusiveness that we have never before learned what Admiral von Trotha has now told us. No preliminary movements were to be made in the Jade; no wireless employed for other than strictly normal

purposes, "because the wireless observing station of the British had become so skillful that they could draw accurate conclusions from reasoning upon the coded orders of the German wireless stations."

The dominant idea was the destruction of the mythical transports assembled for the embarkation of the force that was to violate Dutch neutrality. All available cruisers and destroyers were to sweep down the Flanders coast and attack the mouth of the Thames, whence we may infer that the Germans believed the transport fleet to be assembled at Sheerness. The high seas fleet was to follow in close support. The essence of the scheme lay in the question of distances to be covered. The German fleet would only have 150 miles to travel; the British fleet would have to steam 400 miles to intercept or to engage it. Twelve Zeppelins were to maintain air reconnaissance, and the U-boats that could be gathered were to be strung out in several lines athwart the southward course of the grand fleet.

On paper this reads like a well-plotted enterprise. The German cruisers would have found no fleet of transports, but they might have done a good deal of mischievous bombarding before the channel fleet and the Harwich force could have come to grips with them. By this time the high seas fleet would be on the spot, and the Channel fleet and the Harwich force would have had a very bad time of it, assuming that all went as per program. Here, then, is the German plan, which was only frustrated by the blunt refusal of the lower-deck personnel to carry it out. Let us look at the other side of the picture.

That Lord Beatty and his staff always had in mind the possibility of such an attempted "bolt from the blue" we perfectly well know. He could not, of course, anticipate the precise objective of it, but that the submarine trap would be heavily set was too self-evident to need speculating upon. The Germans themselves perfectly well knew that our naval intelligence was so extraordinarily efficient that as soon as the German ships raised steam to leave the Jade Admirality Beatty would receive the news. The art of strategy lies primarily in reading the enemy's intentions. If the whole high seas fleet were coming out it could only be with the idea of drawing the whole grand fleet out. Whether it intended to seek battle or not, and, if so, where, were questions which must be left to resolve themselves. The obvious thing, to the German mind, would be that Admiral Beatty, in learning that the high seas fleet had left the Jade, would move southwards with all his forces, deploying all his cruisers in a wide sweep, and keeing his battle squadrons together on a course towards Wilhelmshaven until he might get news that enemy ships were in sight. Therefore it would not be very difficult to station submarines to best advantage.

This, I say, is how the German naval staff would presumably reason and consequently act. And because he might pretty well anticipate such reasoning, I think it safe to conclude that Admiral Beatty would not have obliged the Germans by conforming to their expectations. The enemy generally counts upon his foe doing the obvious thing. All feinting would be futile if it were not for this assumption. Had the high seas fleet dash come off I cannot but believe that Admiral Betty would have given the Germans a very considerable surprise.

It is true that the British Admiral would have had no conception as to the real object of the break-out whether it was only a *ruse de guerre*, a big "live bait" trap, or a real desperate operation. But his first and immediate idea on learning that the high seas fleet was out would be to try and prevent it from getting back. The short way to do this would be just the way the U-boats might hope Admiral Beatty would take. The Zeppelins would be a troublesome element, for we may take it for granted that Admiral Scheer would not have put forth save under such weather conditions as would enable them to do their work. Still, both sides had aerial reconnaissance at Jutland, but with very little result.

I suggest that in the situation which presents itself on the strength of Admiral von Trotha's story of the high seas fleet plan there is an excellent theme for students of naval tactics to exercise their ability in developing. In the first place the time calculations of the Germans would probably have proved wrong. Unless the German forces meant to indulge in the "tip and run" tactics of their earlier baby-killing exploits the implied difference between 150 miles and 400 miles would not prove correspondingly wide in point of time. Of course, we must take it that Admiral Scheer would have been largely influenced by reports he might receive as to the movements of the British fleet. If he were really out upon a forlorn hope—and there would be very little purpose in his being out at all otherwise—he must have been prepared for a meeting with the grand fleet. Short of that he could only return to Wilhelmshaven, possibly after doing a good deal of damage which could not have the least effect upon the course of the war at that stage, and await the inglorious end which he and his officers were so anxious to avoid. Further, we may assume that his willingness to meet the grand fleet would rest upon the expectation that the U-boats had taken toll of the British battleships as they came south.

But would they have come south? My own idea is that Admiral Beatty would have steamed east at full power well over towards Horn's Reef, then have turned and come down upon Heligoland. Wherever Admiral Scheer was, and whatever he might be doing, the news that Heligoland was being heavily bombarded by the grand fleet must have completely upset all his calculations. The U-boats would be left far behind, even had some of them picked up the scent and started in chase. The Zeppelins probably might have given tidings of the grand fleet's course and movements. But the point is that Admiral Beatty would be in a favorable position, with the whole of his fleet intact, for joining battle with the high seas fleet. Admiral Scheer might have got back to the Jade before Admiral Beatty could reach Heligoland. But to have done this without attempting something heroic and desperate would have been to negative the whole purpose of the scheme.

Admiral von Trotha says that "everything depended upon whether the British came south. Had they done so they would have found the Germans ready to attack with their entire fleet." This is rather a contradiction of his earlier suggestion that the advantage lay with the Germans in only having 150 miles to cover as against the 400 miles to Scapa. He apparently does not know that at this time the bulk of the British battle fleet was not at Scapa, but at Rosyth. Down to the day of the Armistice Admiral Beatty was always hoping, always expecting, that the high seas fleet would come out, if only for the glory of the young German Navy. He had planned for every contingency which human ingenuity could foresee, and although very few things are certain in war, I think one of those few things is that he would not have done what the Germans expected him to do as an essential condition to their prospects of success.

UNITED STATES

VESSELS UNDER CONSTRUCTION, UNITED STATES NAVY—PROGRESS AS OF JANUARY 31, 1926.

Type Number and Name	Contractor	Per cent of Completion				Contract date of Completion	Probable date of Completion
		Feb.1, 1926 Total	Feb.1, 1926 On Ship	Jan.1, 1926 Total	Jan.1, 1926 On Ship		
AIRPLANE CARRIERS							
Lexington	Beth. SB Corp.	74.5	72.1	73.	70.4		4/1/27
Saratoga	New York S. B. Corp	77.7	77.1	76.	75.3		12/1/26
AUXILIARIES							
Holland	Puget Sound Navy Yard	88.3	87.2	86.2	84.9		6/1/26
FLEET SUBMARINES							
V-3(SF6)	Portsmouth Navy Yd	94.6	93.6	92.1	91.1		6/1/26
V-4(SN1)	Portsmouth Navy Yd	27.9	25.9	24.1	22.1		6/1/26

Authorized but not under construction.

LC24–Plans and specifications issued to New York Navy Yard for preparation of estimates.
LC25–Bids requested but contract not yet placed.
V-5–To be built at Portsmouth Navy Yard. Plans not yet issued.
V-6–To be built at Mare Island Navy Yard. Plans not yet issued.
River Gunboats 43 to 48 inc.—Bids requested but contracts not yet placed.

Authorized by Act of August 29, 1916, but no funds for construction appropriated.

12 Destroyers Nos. 348 to 359 inc.
1 Transport No. 2.
3 Fleet Submarines Nos. 169 to 171 inc.
1 Neff Submarine No. 108.

Authorized by Act of December 18, 1924, but no funds for construction appropriated.

6 Light Cruisers Nos. 26 to 31 inc.

$85,000,000 Navy Air Program Too Much, Is Coolidge's View[1]

The Washington Post, 2 March, 1926.—President Coolidge served notice yesterday on Chairman Butler of the House naval committee that he believes the $85,000,000 five-year building program for the Naval Air Service calls for too large a peacetime expenditure.

Mr. Butler was summoned to the White House to go over provisions in the bill, which his committee has reported to carry out this program. Later, Mr. Butler declined to discuss his conference with the president or to say whether the measure would be amended to meet the executive's desires.

Definite indication was given, however, that the committee chairman is determined to have the house consider the proposal. After his return to the capitol from the White house he introduced a resolution to obtain privileged legislative status for the bill. He hopes to have the measure

[1]EDITOR'S NOTE: Press despatches (March 16) say now President Coolidge approves this program.

called up late in the month under an agreement to limit debate with amendments in order from the floor.

Mr. Coolidge also had an engagement yesterday with Chairman Morin of the House military committee, who, however, was unable to keep it. The War Department has announced it is preparing an aircraft program for the army, although the proposed outlay has not been disclosed. Such legislation will be handled in the house by Mr. Morin's committee.

As for the president's view on aircraft expenditures, he has plainly indicated that, with tax reduction in effect making a treasury deficit possible, he is determined to keep such appropriations down to a point which, in his judgment, adequately safeguards national defense without greatly increasing the cost of government.

The executive has been pressing for congressional action on the recommendations of his air board, particularly for assistant secretaries in the departments of War, Navy, and Commerce to supervise aviation. He apparently views the proposed $85,000,000 expenditure for naval aviation as exceeding what the board had in mind.

On the other hand, Mr. Butler, at the time his committee approved the expeniture, announced it was designed to carry out the board's recommendation for an adequate air service, and several committee members made clear that they viewed the proposed appropriation as the minimum amount that would effect these recommendations.

AVIATION

Aviation in National Defense

By Rear Admiral William A. Moffett, U. S. N. An address delivered before the National Republican Club of New York City, 6 February, 1926.—The sensationalism which has surrounded recent controversies on matters aeronautic has completely obscured the fundamentals of this problem. Under salvos of charges and counter-charges all sorts of ideas have been advanced, until even intelligent observers have been confused. It is vital to the future of our nation that we dispel the smoke screen and look the situation squarely in the face.

Aviation in National Defense has two major rôles, that of air service and air force. By air service we mean that proportion of aviation which is auxiliary to the Army and to the Navy, such as reconnaissance, scouting, and the control of gun fire. By air force we mean that part of aviation which is to be used offensively as a striking force but fully coordinated with the rest of the military or naval forces.

There are two widely divergent points of view of the administration of aviation in carrying out these two rôles. The one looks to complete separation of the administration of all aviation activities from the Army and the Navy. The other looks to the complete unity of these activities with the Army and the Navy. Fundamentally, the question is this: Are we to have a separate Air Force completely divorced from the Army and Navy or are we to continue developing aviation within the Army and the Navy until it takes its proper place in the great scheme of defense. To my mind the separate Air Force idea may possibly give unity in matters aeronautic, but it will most certainly bring confusion to the whole problem of National Defense. But whatever plan we pursue it will succeed if we are loyal to it and it will most certainly fail if we are disloyal.

There are three broad general aspects of the employment of aviation in National Defense: the strategic, the tactical, and the economic. In strategy we consider the dispositions and movements up to the moment of contact with the enemy. By tactics we refer to movements and dispositions in contact and during action with the enemy. Any consideration of the problem must involve an appreciation of the fundamentals of these three aspects.

In strategy there are three rôles, the offensive, the defensive, and the offensive-defensive. It is axiomatic that the best defense is a strong offense. Our whole national policy is based upon a fleet sufficiently strong to safeguard our interests maintained at a proportion of its strength and at a high degree of readiness. It is contemplated that behind the strong arm of the fleet strength may be mobilized in time of emergency. Behind the sure shield of the fleet our industrial organization must be built up. The fleet, then, constitutes the first line of defense. It goes without saying that naval aviation must be in the same degree of readiness as is the fleet itself.

A fundamental strategic consideration is that of position with respect to a possible enemy. This is a matter of pure geography. This country is open to invasion from different directions by overseas nations. Aircraft bases will be required comparatively near our shores for such an enemy offensive. With the fleet at sea fully equipped with its own surface, sub-surface and aircraft no enemy can establish such bases. On the other hand, with the fleet at sea with its own aircraft we can establish our own bases and carry out our own offensive, but this aircraft offensive must be based on the decks of the carriers, that is, on the backs of the fleet. No enemy carrier can approach our shores as long as our fleet is at sea and strong enough to drive off the enemy fleet. In whatever way you look at it, aviation is an integral and important component part of both the Army and the Navy. and its best effort must be directed in conjunction with the Army and the Navy and not independently. The air force of this country should be a naval air force, not a separate air force based on shore. The present joint plans of the Army and the Navy provide for just this.

A fundamental requirement strategically as well as tactically is unity of command. The Navy, responsible for carrying out its mission, must have authority over the operation, training and procurement of its aircraft. Authority and responsibility must go hand in hand. To deprive the Navy of its control over so important a branch as aviation is unthinkable. In our desire to develop aviation rapidly we must not make any mistake of organization which may prove disastrous from the broader angle of National Defense. From a strategic viewpoint the separate air force idea, particularly as applied to the United States, is absolutely unsound in conception.

The same considerations apply from the tactical viewpoint but with even greater force. The essence of tactics is the concentration at the right time and the right place of all the forces available and these forces must be coordinated and trained by intimate association over a long period of time. The commander-in-chief of the fleet at sea must have absolute command over all the forces, surface, sub-surface, and aeronautic. Otherwise disaster will inevitably result.

From the economic aspect the organization of a separate department of the air is absolutely unjustified. The cost of a third department on a parity with the Army and Navy will involve the building up of a vast overhead similar to that of the Army and Navy and will result in triplication of effort. I do not think it physically possible to coordinate three such departments. It is a problem of the very greatest difficulty to coordinate the two departments we now have. With the organization of such a department it would be hard to draw the line. The new air department would probably want all of the surface ships required to tend aircraft operating over the sea and all of the military establishment associated with the operation of aircraft over the land. It would result in the building up within the separate department of a small Army and a small Navy, a thing which is absolutely indefensible on the basis of cost alone. From the economic aspect the idea is again unsound.

We must remember in considering the problem of National Defense that the Army and the Navy are only two of the units involved. Every other department of the government has very great functions in time of war. The machinery for coordinating all of these departments now exists in

the cabinet. The President is the commander-in-chief and the responsible administrative head. There is no need for a separate department of defense.

None of the foregoing considerations are new to those who have had the problem in mind. They are certainly not new to the Navy. In December, 1922, the Navy laid down its aviation policy, which called for a number of important things. Briefly these were to build up a naval air service and naval air force, capable of operating from ships of the fleet, to carry on rigid airship construction and development, and to determine the desirability for further construction; to give every encouragement to aviation in civil life and to maintain the aircraft industry in a sound condition. It is a matter of common knowledge that we have gone far to carry out this policy in a little over three years. The essential fact is that the fundamentals of the employment of aviation in national defense have been long understood by the Navy, that based on them a definite policy has been laid down and that this policy has been carried out to a surprising degree. We know where we're going and we're on our way.

During the World War we had to subordinate all of our aeronautic activities both in the Army and the Navy to three tasks: the construction of observation type airplanes for the Army, the construction of coastal patrol or anti-submarine defense seaplanes for the Navy, and the training of the officers and men to man and operate these two types. The close of the World War then found us with the satisfactory development in but three of the many types required for our defense. Since the World War the Navy has carried on the improvement and refinement of these patrol types as exemplified in the *PN-9's,* which are holders of world's records both for distance and duration for seaplanes. We have designed, built, and equipped the fleet with observation and gun spotting airplanes which are catapulted from the ships. With these we have developed our air service with the fleet to a high degree of proficiency. No other nation has gone so far. We have designed, built, and furnished the fleet with combined torpedo, bombing and scouting planes capable of operating from ships or shore. So far as we know, no other nation has carried the development so far.

Whereas foreign countries had aircraft carriers in operation during the war, we had none, because we put our whole effort on anti-submarine defense. Since the war we have built and operated an experimental carrier, the *Langley.* We have designed and launched the two carriers, *Lexington* and *Saratoga,* and we are now building the aircraft which will fly from them and constitute the naval air force. We have built one rigid airship and procured another. We have operated them with greater success than any other country, even taking into consideration the lamentable loss of the great *Shenandoah.*

All of these developments have been very difficult. They called for engines of new design, airplanes of new design and all of the instruments and accessories which go along with this complicated art. When we remember that it takes about three years to develop an airplane we can appreciate the magnitude of the Navy's effort in the past three years.

The necessity for national economy has in turn forced economy on us. Instead of building a large number of airplanes which would be absolescent or worn out by now we have built only that number which appeared necessary in view of the general situation and have confined our efforts to the improvement and refinement of types. As a result we are not excelled in the performance of our service airplanes and we are building up the numbers to a degree which economy will permit. The budget and Congress have been generous with us and considerate of us. We are unexcelled in quality. I believe Congress will approve our five-year program and put us in a satisfactory position as to quantity.

All of our development has gone ahead in the face of continued criticism and agitation. In spite of the fact that we have been distracted from our

legitimate work by this we have pushed on. To my mind the single biggest handicap under which aviation has had to suffer is the repeated attacks and charges on the part of individuals who are totally ignorant of the Navy and its problems and who have been impelled largely by unworthy motives in their efforts to discredit us. However, we are not concerned, for the record of our achievements is a solid bulwark against the ravings and rantings of publicity seekers.

One of the most important branches of naval aviation is that portion which is employed in coastal defense. There are certain influences at work endeavoring to deprive the Navy of this important task. It is well to remember that aviation in coast defense is a very important branch of convoy and anti-submarine defense work. It was developed to a very high degree by the Navy in the war, as every soldier knows who left the home port under the escort of Naval seaplanes and airships and arrived at his destination under the same kind of rescort. This is a seagoing function which in time of emergency must be under the command of the naval officer responsible for convoys. Naval aviation in coast defense must have its air stations from which to operate just as the fleet must have its bases from which to operate and yet today there are people who would like to deprive the Navy of these primary requisites to success.

We have a five-year program for rigid airship construction covering two great six million cubic feet airships and a base on the Pacific coast. These two ships can cruise between London and New York, carrying forty tons of passengers, mail, and express, making the passage in two and one half days. Rigid airships now are where steamships were one hundred years ago. If we continue airship development you will see these big liners enter this great harbor, and I want to see them under the American flag.

We have a carefully considered five-year building program for heavier-than-air craft and will have a magnificent naval air force of 567 fighting and bombing planes and an air service of 665 more. This will give us a total of 1,232 naval aircraft as a sure guaranty of peace.

We of the Navy do not advocate scrapping any arm of our present defense. We do not impugn the motives of any sister service. To us it is unthinkable for any real American to question the motives of his brothers in arms or charge them with treasonable conduct. The Navy is in full accord with the Morrow Board's report, approved by the President, our commander-in-chief.

In closing, I would like to urge that you be not alarmed as to aviation in the Navy. We are and have been fully alive to its value. We have assigned ourselves a definite task and have accomplished the task to a degree which is really surprising to anyone who realizes the complications involved. We have steered a true course and have not been misled by false lights along the shore put there by self-seekers, ignorant of the seaman's job and ignorant of the fundamentals of the problem. Your Navy has always served you well and it will continue to serve you well through all the vicissitudes of war and peace. Behind your great fleet including this air service and air force, you continue to go about your lawful pursuits in peace and prosperity.

The Pratt and Whitney Wasp Engine

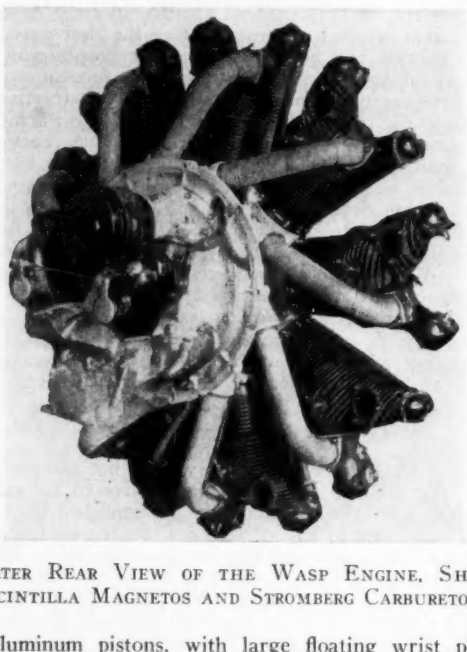
A New Radial Air-Cooled Engine of Very Low Weight Per Horsepower, *Aviation*, 15 February, 1926.—In a recent issue of *Aviation* announcement was made of the development of a nine-cylinder radial aircraft engine by the Pratt and Whitney Aircraft Company, of Hartford, Connecticut. The first detailed description of the engine, known as the Wasp, which has just completed the Navy 50 hours test, is now available.

The engine develops about the same horsepower as the Liberty on a reduction of about 200 pounds in dry weight. This is equivalent to a dry

weight per horsepower of 1.69 pounds, which is quite the lowest weight thus far obtained with a radial type. The elimination of the cooling system and the reduction in dry weight will result in a powerplant having the same output as the Liberty, but weighing approximately a quarter of a ton less.

Dependability and durability were considered as the first and foremost considerations in the Wasp design. To this end, difficulties arising in the design of radials were carefully analyzed, and the new design was carried out with provisions for eliminating these difficulties. For example, the crankcase was split on the center line, the two halves being held together by the cylinder flanges and large through-bolts in such a way as to make the front and rear sections interchangeable. This makes the crankcase construction very simple and rugged.

It is obvious, from the design of all the power transmitting parts, that great care and long experience is embodied therein. Substantial, heat-



THREE-QUARTER REAR VIEW OF THE WASP ENGINE, SHOWING THE SCINTILLA MAGNETOS AND STROMBERG CARBURETOR

treated cast aluminum pistons, with large floating wrist pins are used. The master rod is a very good piece of rugged, yet graceful, design. All the rods are I section to provide for visual inspection of the materal, which would not be possible with tubular construction. The crankshaft is very short and robust. It is carried on three N.K.A. roller bearings. An unusual feature is the extension of the crank webs on the side opposite the pin to form part of the counterweights.

Another troublesome feature in radial engine design has been the valve gear, which invariably has been exposed and not well lubricated. In the Wasp, the rocker arms are carried in housings which are cast integral with the cylinder heads. This, together with the enclosing tubes for the push rods, entirely protect the valve gear. Extremely long valve guides are used which not only carry away the heat rapidly from the exhaust valves

but also provide sufficient guiding area to eliminate scored valve stems, frequently a common trouble.

Another feature which adds to the dependability of the powerplant is the location of all the accessories at the rear of the engine, as is shown by the three-quarter rear view photograph. Here are grouped two Scintilla magnetos, a Stromberg carburetor, the fuel and oil pumps, two synchronizer drives, the tachometer drives, and the generator drive, as well as the oil strainer and relief valve. An Eclipse momentum starter is carried between and just above the two magnetos. These units would all be readily accessible from two doors, one on each side of the fuselage of an airplane equipped with the Wasp engine.

Aside from these major design features all the parts which transmit the power of the engine have very high factors of safety. The size of all these parts is noteworthy in view of the extremely light weight per horsepower of the engine, indicating that low weight per horsepower has been secured by simplified arrangement rather than by weakening any important parts. All the unimportant parts are as light as possible, consistent with ruggedness, and duralumin and aluminum are extensively used.

To obtain a high power output, an improved cylinder construction has been used with very large valves, together with an unusual amount of cooling surface, both on the cylinder heads and on the exhaust valve guides.

This efficient cooling enables the engine to develop full power on domestic aviation gasoline, which is an important consideration. A general electric type supercharger is built into the engine at the rear. On account of the main crankcase construction it has been possible to save considerable weight in other crankcase sections.

The Wasp is extremely clean in external design, and mounted in a plane, nothing would be visible but the cylinders and nose of the crankcase. As the accessories are all in the rear, it is not necessary to cowl the engine at all.

It is interesting to recall that work on the design of this engine began early in August, 1925, and, within a period of six months, the first of the type has been constructed, put through a preliminary test and now completed the standard Navy 50 hour test. The high power and low weight characteristics of the engine are most notable features.

ENGINEERING

Marine Auxiliary Machinery

Engineering, 12 February, 1926.—In recent years considerable improvements have been made in the design of machinery for the propulsion of ships and, in consequence of this, the auxiliary machinery is now responsible for an appreciable proportion of the total fuel consumption. It is therefore, necessary to investigate all the factors that make for efficiency in such auxiliaries in order that the consumption may be reduced to a minimum and the best possible results obtained for the fuel used for all purposes. There are, of course, alternative types of every class of auxiliary already available, and these may be driven by steam or electricity. Variations in the results may therefore be anticipated and it is desirable that marine engineers and shipbuilders should have information on the magnitude of these. At a time when some of the most progressive of our leading engineers and ship constructors are contemplating the use of high steam pressures and superheats aboard ship for the sake of economy, it is vitally important that the most efficient auxiliaries should be used. No one sees this more clearly than Mr. Stanley S. Cook, who read a paper on "High-Efficiency Steam Installations for Ship Propulsion with Special Reference to the Question of Auxiliary Machinery," at a meeting of the Institute of Marine Engineers, on Tuesday, February 2.

The developments in land practice of steam turbines for the generation of electric power, he said, had brought into prominence the value of

securing the conversion of heat into mechanical energy on the highest scale of efficiency that thermodynamic laws allowed. At the World Power Conference in 1924, the Hon. Sir Charles A. Parsons read a paper in which he gave the thermal efficiencies attainable in steam plants under practical working conditions with high boiler pressures and temperatures. In such installations a thermal efficiency, from fuel to electricity, of 30 per cent was realized and the fuel consumptions were as low as 0.45 pounds of oil per brake horsepower hour. In marine propulsion, during the last twenty years, there had been an increase in overall efficiency of practically 100 per cent, resulting from combinations of improvements in turbine efficiency and propeller efficiency through using suitable speeds, made possible by the introduction of gearing, and the increase in available energy due to the use of superheat. It was now hoped to realize at sea the considerable improvement obtained in land power stations, and designs of plant for the purpose had been worked out. Two examples of 27,000 shaft horsepower and 13,500 shaft horsepower were dealt with in a paper read by Sir John Biles at a meeting of the Institution of Naval Architects, when he showed that high-efficiency steam turbine plant, on an economic basis, had advantages over Diesel engines. The most efficient arrangement of marine turbines in recent installations was recognized as one consisting of three or more turbines in series, grouped around a common gear wheel, through which their power was transmitted to the propeller shaft. With this arrangement, the turbines ran at high speeds of rotation and had a high relative blade speed. They were at the same time of moderate size, easily overhauled and of rigid construction. Such an arrangement had therefore been retained for the new designs making use of a greater range of steam expansion.

Economy in total fuel consumption was the ultimate aim, and while higher efficiences were now obtainable by the use of steam at high pressures and temperatures in the main turbines, equal consideration had to be given to questions involving the consumption of the auxiliaries. Although the power required to drive the various components of the auxiliary plant was small, the rate of consumption was universally high. In direct-acting pumps, for example, the steam was used nonexpansively. The effect upon the total fuel consumption was not obtained by the simple addition of the auxiliary steam consumption to that of the main turbines. It was generally the practice to exhaust the steam of the auxiliary engine against a back pressure, a few pounds above atmospheric, to enable the heat of this steam to be utilized for feed-heating. As much as possible of this available heat was recovered, and it was, therefore, sometimes contended that the actual consumption for driving the auxiliaries was small. This, however, was not a true view of the case since there were two other economical means of supplying the required heat to the feed water, viz., by the use of economisers and by means of steam tapped off from the turbine at suitable pressures.

Mr. Cook, after describing briefly in his paper the chief components in a ship's auxiliary plant, proceeded to discuss the results obtainable with four different methods of driving the auxiliaries for a plant of 5,000 shaft horsepower. The methods were: entirely by steam; by electric motors, with current supplied from turbo-generators; by electric motors, with current supplied from Diesel generators; and mechanically from the main engines, with the provision of suitable standby plant. With a boiler pressure of 500 pounds per square inch, superheat to 700 degree Fahrenheit and a condenser vacuum of 29 inches of mercury, the steam consumption of the main turbines was estimated at 7.2 pounds per shaft horsepower. The consumptions and duties of the various auxiliaries had therefore to be based on a condensate of 36,000 pounds per hour. Auxiliary exhaust steam, at a pressure of 10 pounds gauge, was available to heat the feed water to 215 degrees Fahrenheit. When the auxiliary steam was

insufficient for the purpose, the additional requirement would be obtained by taking steam from the L.P. turbine steam belt. The feed water might be further heated to a temperature of 310 degrees Fahrenheit by steam withdrawn from the I.P. turbine at a pressure of 180 pounds absolute.

If the auxiliaries were entirely steam driven, their consumption, including that of the ejectors, the makeup feed, and the steam used in the evaporator, would be 8,960 pounds per hour. Of this, 1,500 pounds would be condensed in the evaporator coils and 250 pounds in the oil fuel heater, leaving 7,210 pounds available for feed heating. To heat the remainder of the feed water from 70 degrees Fahrenheit 215 degrees Fahrenheit required 5,800 pounds of steam, leaving 1,410 pounds unutilized. This might either go to the winch condenser or be lead to the L.P. turbine. The total steam consumption for all purposes would therefore be 44,960 pounds per hour or 8.99 pounds per shaft horsepower hour, corresponding to an oil consumption of 0.681 pounds per shaft horsepower hour. By utilizing steam tapped off from the turbines to raise the feed water to 310 degrees Fahrenheit, while slightly more steam was used it was generated at a higher evaporative rate and the figure for oil consumption for all purposes would be 0.667 pounds per shaft horsepower hour.

The second proposal was driving the auxiliaries by electric motors supplied from turbo-generators, taking steam at the same pressure and temperature as the main turbines, but exhausting at a back pressure of 10 pounds gauge. At a consumption of 45 pounds per kilowatt they would require 4,950 pounds of steam per hour. With the same addition as before, of 2,700 pounds per hour for the ejectors, makeup feed and evaporator, this gave 7,650 pounds per hour as the auxiliary consumption or 43,650 pounds per hour for all purposes. This was equal to 8.73 pounds per shaft horsepower, which corresponded to an oil consumption of 0.662 pounds per shaft horsepower. This again could be reduced by tapped off steam to heat the feed water and the result would be 0.648 pounds per shaft horsepower.

As an alternative, the supply of electricity for the motors driving the auxiliaries could be obtained from Diesel generating sets. Again, 110 kilowatts was required, but the additional steam for ejectors, makeup feed and evaporators was 2,450 pounds per hour with only 850 pounds per hour available for feed heating. Since, however, in this case, 4,950 pounds per hour was required to heat the feed water to 215 degrees Fahrenheit, this 850 pounds must be supplemented by 4,100 pounds of steam tapped from the low pressure turbine belt, at an expense of a reduction of the power developed in the turbine of 285 shaft horsepower. At a consumption of 0.75 pounds of oil per kilowatt hour the Diesel generator would consume 82.5 pounds of oil per hour which, at an evaporative rate of 13.2 pounds per pound of oil was equivalent to 1,090 pounds steam per hour. Finally, for this suggested scheme, 4,715 shaft horsepower was obtained for a total equivalent consumption of 39,540 pounds of steam for all purposes, or 8.39 pounds per shaft horsepower. The oil consumption for all purposes would then be 0.635 pounds per shaft horsepower hour if the feed temperature were 215 degrees Fahrenheit or 0.62 pounds per shaft horsepower hour if it were 310 degrees Fahrenheit.

Should the 118.5 brake horsepower needed for the auxiliaries be obtained mechanically from the main turbines, the output, allowing for mechanical losses would be reduced by 132 shaft horsepower and similar steam quantities would be needed from the turbines for feed heating as in the previous scheme. Under this arrangement, the steam consumption would be increased by 2,450 pounds per hour and the output reduced by 417 shaft horsepower. The total consumption would be 38,450 pounds per hour for an output of 4,583 shaft horsepower or 8.39 pounds per shaft horsepower—a similar result to that obtained in the previous proposal.

The Welding of Aluminium

The Engineer, 12 February, 1926.—Despite the fact that the welding of aluminium has been regarded as one of the most difficult of crafts, successful work is commonly done in many applications. The reason for the belief that a long period of training and experience is essential to the production of successful work is due entirely to the characteristics of the material being so different from those of steel, cast iron and other metals, with the treatment of which the general welder is familiar. Explanations of the many peculiar physical actions taking place during the welding of aluminium were given at a meeting of the British Acetylene and Welding Association, on Thursday, February 4, by Mr. Edgar T. Painton, of the British Aluminium Company, Limited.

The fundamental source of difficulty in the welding of thin sheets, not suitable for the simple pressure welding used in connecting electrical wires and cables of aluminium, was stated to be the rapidity with which the metal oxidised and the toughness and tenacity of the oxide film which was formed. In the simple butt-welding process, the oxide skin was broken by the application of the pressure. Once the ends of the rods were heated to the melting point, the metal was prevented from falling away by the oxide skin which, however, was ruptured and allowed the clean metal in each part to come into association as soon as the pressure was put on. This mechanical process had its counterpart in oxy-acetylene welding, in the removal of the oxide as it was formed by the so-called puddling method. One disadvantage that had to be contended with, was that the oxide of aluminium had a higher specific gravity than the metal and tended to sink to the bottom of the pool of metal. There was consequently great risk of inclusions within the solidified metal.

The most effective way of removing the oxide in an aluminium weld was by the use of a flux. While aluminium oxide was not acted upon by many chemical reagents, it had been known, since the beginning of the aluminium industry, that the oxide could be dissolved by molten halogen salts of the alkaline metals. Cryolite, a natural double fluoride of sodium and aluminium, proved a useful component of many fluxes for the purpose, but other fluorides and chlorides were mixed with it in order to vary the melting point, the viscosity of the molten flux, its density and the speed of action. Lithium chloride, for example, was nearly always a component, since it had a very low melting point and produced a flux which was liquid, and flowed freely before the aluminium itself reached its melting point. An aluminium flux should not be too fluid, however, or under the blast of the blowpipe it might spread and leave too little on the weld to perform the work of removing the oxide successfully. For aircraft work a flux was used consisting of potasium chloride 45 parts, sodium chloride 30 parts, lithium chloride 15 parts, potassium fluoride 7 parts, and potassium bisulphate 3 parts. This was a good flux for all general purposes, but many different mixtures were on the market which had their adherents. All aluminium fluxes were hygroscopic and had to be kept in aircraft containers. Dr. Briscoe and Captain Richardson discovered that the use of pyrosulphate or pyrophosphate in the mixture prevented the dissociation of the components, and thus it was possible to provide a flux which could be stored for long periods without deterioration.

Furnaces and Combustion

The Engineer, 22 January, 1926.—Combustion, like all other changes, takes time for its completion. From the slow rusting away of iron to the practically instantaneous detonation of an explosive, we have a range of phenomena all possessing the characteristics of combustion, yet differing enormously in the time required for the combination of oxygen with its

particular fuel to take place. The kind of combustion which particularly interests the steam engineer is that of coal. He has to provide the necessary facilities for bringing the coal and oxygen together in proper proportions, and the faster the chemical reactions can be carried out, so long as they behave themselves quietly, the greater is the commercial efficiency of the process. A slow rate of burning necessarily means large furnaces. These are not only more costly in themselves and in the housing they require, but they are, in general, more expensive to maintain than those of smaller dimensions. Now that single boiler units are being constructed with an evaporative capacity enormously greater than that of only a few years ago, the size of furnaces is becoming an important consideration. A large modern boiler may consume as much as ten or twelve tons of coal per hour, and since the faster a ton can be made to disappear, the smaller will be the grate area and the less the furnace volume required, the highest practicable rate of combustion is obviously to be desired. It is only during the last few years that much attention has been paid to the relationship between furnace volume and boiler capacity, and as every engineer knows, there is no general agreement on the subject. In current practice, with mechanical stokers, the furnace volume usually lies between 250 and 450 cubic feet for every 1,000 square feet of boiler heating surface, though important installations are to be found even outside these limits. The tendency seems to be to increase furnace volumes, rather than to diminish them, and modern ideas would hardly sanction less than 350 cubic feet per 1,000 square feet of heating surface. At Hell Gate power station, with Taylor stokers, there are 8,000 cubic feet of furnace volume to 15,900 square feet of heating surface. For burning coal in a pulverized form the furnaces are much larger, and here, again, the tendency appears to be towards even greater size. At one of the American powdered fuel stations there are boilers with over 800 cubic feet of furnace volume per 1,000 square feet of surface. Mr. Patchell, at a meeting of the Institution of Mechanical Engineers last year, said that to stand in one of these furnaces was "like being in a cathedral." Now, cathedral-like structures, even if they are not disproportionate in size to the boilers above them, are very expensive, and the larger the boiler the more important it becomes to keep down the relative size of the furnace, if this can be done without sacrifice of efficiency.

The whole question of furnace sizes seems to turn on the point of how many heat units can be liberated per cubic foot of volume in a given time. Since the heat units are only generated, directly or indirectly, at the surface of the coal, it would appear that the burning surface may be as great as possible for a given quantity of coal. In other words, the finer the coal the faster it could be burnt. This argument would lead to the conclusion that pulverized coal should require less furnace volume for a given heat output than coal burnt in solid form. Such, however, is not the case. A powdered fuel furnace is nearing the limit of its efficient performance when producing 20,000 B.T.U. per cubic foot of its volume. Three times as much heat can be developed per cubic foot of stoker-fired furnaces, and even these are surpassed by hand-fired locomotive or Scotch marine boilers. It is evident, then, that some factor has been left out of consideration. Fuel surface alone is not the only requisite to rapid combustion; an adequate supply of air to the burning surfaces is the other requisite. The quantity of fuel burnt per hour in a given space would seem to have no limit if oxygen could be brought up to the burning surface rapidly enough. In gunpowder, where the oxygen is actually present in sufficient quantity, the carbon is burnt almost instantaneously, and no volume greater than that of the charge itself is necessary for complete combustion. The only way we can hasten the combustion taking place on a given surface of coal is by increasing the draught so that the supply of oxygen is renewed with greater rapidity. If, in the desire to have the

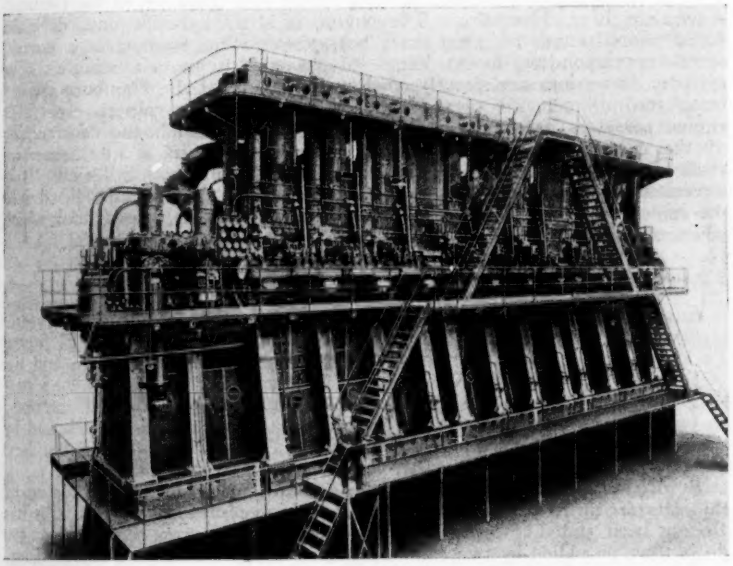
maximum burning surface we reduce the coal to such a fineness that it will not stay still against the draught we defeat our ends. This is one of the reasons why pulverized coal burns so slowly per cubic foot of furnace volume. The individual particles are protected against burning by their very lightness. Each becomes surrounded by its own little atmosphere of carbon dioxide, and however violent the turbulence in the furnace, the particle travels about for an appreciable time, much as a balloon in a hurricane, moving with the gases and therefore unaffected by their velocity. It would be destroyed in an instant if it could be kept still, so that its protecting atmosphere could be swept away and replaced by more oxygen. In this connection reference may be made to a plan put forward by a French engineer, M. Jules Deschamps, and described in our issue of February 6, 1925. By employing pulsations in the supply of air to furnaces, M. Deschamps has succeeded in meeting the retarding influences to which we have referred, and greatly accelerating combustion. There is also the practical difficulty, when using a heavy draught to get the necessary amount of air through a burning coal bed, that the lighter particles are blown away altogether before they are consumed. Everyone who has tried to burn coke breeze with forced draught knows how much of the fuel is carried away unburnt, and lodges in the economizers or distributes itself over the neighboring landscape by way of the chimney. It is quite a tenable proposition that, from the point of view of developing the maximum of heat in a given space, the principle of burning fuel in a pulverized form is unsound, for the reasons we have indicated. Pulverized coal systems have other advantages, such as ease of control and high efficiency of combustion, but those are matters with which we are not at the moment concerned. Yet it is interesting to reflect upon the fact that the same ends may be reached by the diametrically opposite path. It is possible to imagine extremely high rates of combustion brought about by air jets playing on the incandescent surface of the layers of briquetted fuel, suitable provision being made for the elimination of ash and slag as fast as they are produced. Experiments on these lines, especially if comprising the principle of using the radiant heat from the fuel bed to the utmost, might have a marked influence on boiler design. The system of burning coal in a pulverized form has been tried on a sufficient scale to make evident both its merits and its defects, and an experimental move in the opposite direction would at least be instructive.

The most efficient use of furnace volume is probably made when oil is burnt with mechanical atomizing. Under such conditions, it is easily possible to liberate 100,000 B.T.U. per hour per cubic foot of furnace volume, and figures more than half as great again have been recorded. This, it may be said, is the very antithesis of solid fuel burning, and is the limit to which pulverization is tending. Any analogy, however, between pulverized coal and atomized oil is an unsound one. The finest possible particle of pulverized coal consists of an incredible number of molecules, which are only separated from it one by one as oxygen comes within their radius of action. The particle is still a solid, even if, according to our ordinary standards of comparison, it is a small one. A particle of oil, on the other hand, is a liquid, and at furnace temperature it becomes gasified, each molecule taking its own path at a high velocity among the other molecules of the furnace gases. It has thus an excellent chance of rapid combination with any unattached oxygen. The central molecules in the coal particle, moreover, have to wait their turn for combination until all the exterior particles have been carried away, whereas the evaporation of the oil particle allows all its molecules to have their chances simultaneously. The solution of the problem of burning coal lies in the direction of keeping the air supply in continuous and violent attack on the carbon. That is achieved by employing very large furnace volume with powdered

fuel, but it is worth considering if the rate of combustion of solid fuel could not be increased in furnaces of relatively smaller size.

A Large Double-Acting Oil Engine

The Engineer, 29 January, 1926.—Preliminary tests were recently completed at the yard of Blohm and Voss, Hamburg, of a nine-cylinder double-acting two-cycle oil engine built under license from the M.A.N. Company, Augsburg. It is, so the makers claim, the largest unit yet constructed, either for land or marine work. The accompanying illustration shows the engine as erected for testing at the builders' works. It will be employed for driving a 10,000 kilowatt alternator at the Neuhof Electricity Works, Hamburg. Some of the principal particulars of the set are given below:



15,000 B.H.P. Two-Cycle Double-Acting Diesel Engine

Engine Particulars

Total designed output	15,000 B.H.P.
Number of cylinders	9
Cylinder diameter	860 mm.
Piston stroke	1,500 mm.
Normal speed	94 r.p.m.
Overall length to generator coupling	23.4 m.
Overall breadth	4.3 m.
Height from centre of crank shaft to the top of the valve gear	10 m.
Overall height, including oil pump of bed-plate	11.8 m.

Generator Particulars

Normal output	10,000 kilowatts
Voltage	5,000–6,000 volts
Periodicity	50 cycles

The generator has been designed and built by the Siemens Schuckert Company, of Berlin. It is water cooled, and presents several new and interesting features.

With the engine arranged as shown in the accompanying illustration, it was not possible—owing to lack of sufficient load—to measure the full power, but we learn that very satisfactory running tests were carried out, and the power was taken first with the upper and then with the lower ends of the cylinders in operation.

When the engine has been reerected in the Neuhof power station, full electrical tests will be carried out, and we hope to give detailed particulars of both the engine and generator, together with some of the test results, in a few months' time.

We recently had the pleasure of witnessing at Augsburg the preliminary trials of an engine of a similar design, which was built by the M.A.N. Works, Augsburg, for the single screw motor ship *Rameses*, of the German-Australian Line, Hamburg. The engine is a six cylinder unit, designed for a nomal output of 4,400 shaft horsepower when running at a normal speed—corresponding to 13 knots—of 84 revolutions per minute. The cylinder dimensions are slightly smaller than those of the Hamburg engine, being 700 millimeters bore and 1,200 millimeters stroke respectively. This engine possesses new features of design, both as regards the construction of the cylinders and the scavenging arrangement. In a later issue we shall give some particulars of the new M.A.N. double-acting design. It is interesting to note that four engines of the same type will be fitted into the motor ship Augustus, which is now being built at Genoa, and which when completed will be the largest motor vessel afloat.

The R.M.S.P. Motorship "Asturias"

Engineering, 12 February, 1926.—The official trials of the motor vessel *Asturias*, the latest adition to the passenger fleet of the Royal Mail Steam Packet Company, were held on February 8 outside Belfast Lough, and the vessel then proceeded to Southampton with a numerous company of passengers representative of shipping, shipbuilding, and engineering interests. In our last volume we gave some leading particulars of this vessel, and by the courtesy of the company and of Messrs. Harland and Wolff, the builders, are now able to add some further information in regard to it.

Before we pass to these details the circumstances of what is known of the *Asturias* up to now seem to warrant some general observations. As has already been stated, the present *Asturias* is a twin-screw vessel of 22,500 gross tons, propelled by two sets of Harland B. and W. double-acting, four-stroke cycle Dielsel engines, with eight cylinders each, which between them develop a normal 20,000 i.h.p. She is accordingly both the largest and the most powerful motor vessel at present in service, and likewise the first British vessel to be propelled by engines of her type. Though her engines follow closely the lines of the single-acting Harland B, and W. engines, it is in the characteristic tradition of Messrs. Harland and Wolff that their first production of the double-acting type should be on a larger scale than has been known hitherto in motor vessels. Independently of her engines, the *Asturias* is expected to maintain the established reputation of the company's A-boats for exceptional comfort and convenience. The particulars that we give below show that the success which has attended the operations of the company and the builders in advancing the standards of practice in past years seems to have been attained again, but in the more exacting and difficult conditions of the present time. Having regard to these circumstances, as well as to the other important work on the same lines that is understood to be in hand or in active contemplation, and to the plastic state of professional opinion in regard to the commercial value of large motorships, the entry of the present *Asturias* into service may mean more than

the mere addition of a fine vessel to the fleet of a great company, or even than a striking advance on present practice. It may constitute a notable epoch in the development of naval architecture, which deserves fully the considerable attention it is receiving.

It may, perhaps, be of most interest in the first instance to deal rather with the general nature of the advance that the engines have made, and the results they have already attained, than with the details of their construction. The eight cylinders of each engine are 840 millimeters in diameter by 1,500 millimeters in stroke, and except for the substitution of double for single actions, and consequential alterations of design, the engines are practically indistinguishable at top and at bottom from the Harland B, and W. single-acting type, a number of which are running on vessels of the Royal Mail Company. Nevertheless, though the *Asturias* cylinders are only 4 inches larger in diameter than many of the single-acting type already in use, they develop about three times the power; a gain, after allowing for difference in size, that can be attributed only to the introduction of double-action, which is the sole significant alteration in design between the two types. The narrow limitation of this difference makes the results obtained up to now in practice the more cogent and important. It is, therefore, satisfactory to be able to record that the official trials last Saturday, and the subsequent run from Belfast to Southampton, were entirely uneventful. The ship had the happiness of a country without a history. No incident whatever occurred, the whole of the propelling and auxiliary machinery worked with perfect smoothness, and on berthing at Southampton on Monday morning the handiness of the ship and the excellent maneuvering of the engines were very remarkable. Throughout the trip, moreover, the vessel was considered to be conspicuously free from vibration, which was the more remarkable because, carrying no weightier cargo than the portmanteaux of her guests, she was exceptionally light in the water.

This is a matter of the more consequence, because previous experience could not be a safe guide to what might be expected in the complex matter of vibration from so far-reaching a change as the increase from 4,000 h.p. or 5,000 h.p. on a single shaft to 20,000 h.p. on two shafts. The occasion, moreover, of having so large a number of passengers more familiar with shipping than the average traveler gave particular weight to what was a general and undisputed opinion, and left no doubt that the *Asturias* compared favorably in respect of freedom from vibration with vessels fitted with any type of steam propulsion.

The results described above are, of course, merely qualitative, though they were obtained without difference of opinion by a considerable number of qualified observers. The preliminary trials, including the acceptance trials, had, however, yielded more positive results. The trials were begun on January 12, when the *Asturias* crossed from Belfast to the Clyde and immediately undertook a 48 hours' run at full power, making two double runs from the Clyde to the South of Ireland and back at service revolutions. Here again there was an entire absence of incident, the whole of the machinery behaving faultlessly. At the end of the 48 hours' run a series of trials were run on the Skelmorlie mile at from 92 r.p.m. to 122 r.p.m. Full records were taken, from which two or three figures may be quoted. At 122 r.p.m. the engines developed well over 23,000 i.h.p. The fuel consumption, though doubtless taken separately, is quoted as a whole for main and auxiliary engines, and the two oil-burning vertical boilers. Worked out for continuous running at the normal full service power the fuel consumed per 24 hours was 70 tons, or less than one-third of a pound of fuel per indicated horse power. When this figure is compared with those of the large number of results that have been obtained from other motor vessels, it is evidently one on which the owners must be congratulated, though it is said to be in close agreement with the estimate of the builders.

The Contra-Propeller Stream-line Rudder

The Shipbuilder, February. 1926.—Very interesting trials have recently been made at the Hamburg Experimental Tank with the contra-propeller stream-line rudder, a new invention of Dr. Wagner, the inventor of the contra-propeller.

The idea of this rudder is that the resistance which is normally offered by a rudder to the water, and which is of much greater importance than

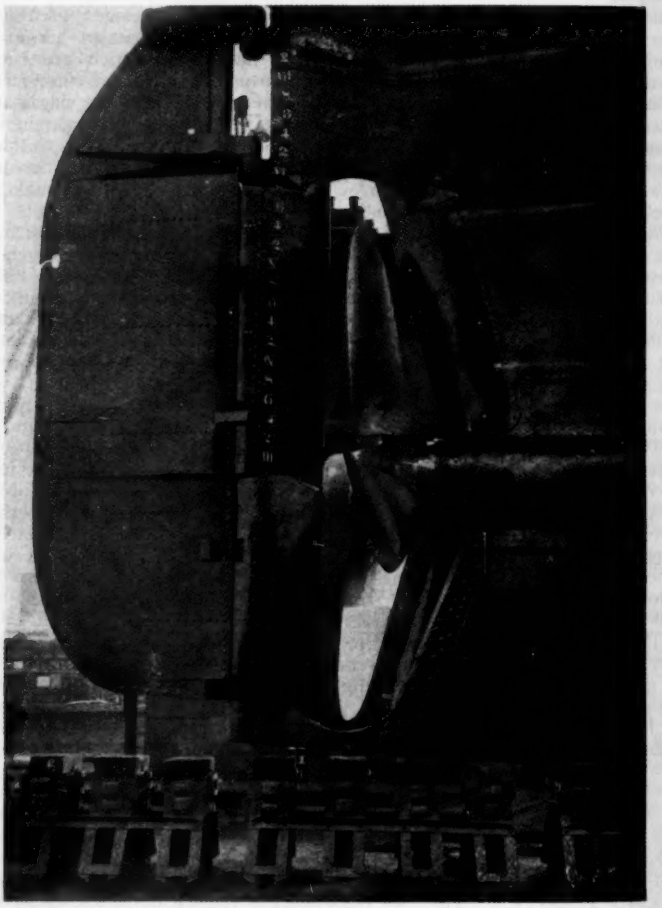


FIG. 10. THE CONTRA-PROPELLER STREAM-LINE RUDDER OF THE S.S. "EMIL KIRDORF"

generally thought, is reduced as much as possible by giving the rudder, and also the rudder-post, a stream-line form. Further, by adopting a different and eccentric form above and below the axis of the propeller shaft, the rudder serves as a two-bladed contra-propeller, utilizing the wake of the

revolving propeller. The new rudder, which may be adapted to any normal single-screw vessel, consists of a plate skin stiffened by angle bars. Its form includes the stern-post, rudder-post, rudder arms and the rudder blade, the horizontal section resembling that of an airplane wing. There are, of course, two different parts, one forming the stern-post and the other the rudder blade proper, but the space between these parts is as small as possible and of just sufficient amount to permit the rudder turning. The forms of both portions conform fully to a mutual stream-line flow. Above the propeller axis the rudder section is curved to one side, and below to the other, just as with any ordinary contra-propeller.

The new rudder has originated from experience with the preceding forms of contra-propellers. Such experience has shown that the vertical arms of any contra-propeller are more efficient, as the gain in thrust made by them is not reduced by an increase in resistance, these blades being incorporated in the vessel's rudder-post, which in itself gives a considerable resitance. The side blades of contra-propellers offer a certain additional resistance to the travel of the vessel, and this resistance is only exceeded a little by the thrust of the side blades. The first contra-propellers were built with six blades. Then contra-propellers with four blades only were tried, and these proved to be of about the same efficiency. Dr. Wagner has now dispensed with the two remaining side blades, and a very decided improvement is claimed for the unification of the rudder-post and the rudder with all its parts in a single stream-line form with a minimum of resistance.

The experiments at the Hamburg Tank have shown that the usual irregular forms of the square rudder-post. the round rudder-shaft and the arms much hindered the stream of water coming from the propeller, thus reducing considerably the propulsive efficiency. Trials made with the model of a large freighter of full form, with a displacement of 12,000 tons, and of good speed, showed that the engine power necessary to propel the vessel at her service speed may be reduced by about 25 per cent if the stream-line contra-propeller rudder is fitted. Alternatively, with the same power, a gain in speed of about three-quarters of a knot was found to be possible. These results are now being tested in an actual ship. The vessel in question has been fitted with the new rudder, and is at present making a voyage to the Far East. Another, but smaller, vessel has also been fitted with the new rudder.

Apart from the reduction of resistance, it is claimed that the new rudder results in a decided improvement of steering qualities, because the usually considerable distance between the stern-post and the rudder-shaft has been filled in, and because the lateral area of the stern-post has been much increased. Thus, when the rudder is put over, there is not only a side water pressure upon the rudder blade, but also upon the stern-post, and the vessel is turned faster; while the power exercised by the steering engine is not larger than usual.

Figure 10 is reproduced from a photograph of the contra-propeller stream-line rudder of the steamship *Emil Kirdorf,* owned by the Hugo Stinnes Lines.

MERCHANT MARINE

Shipping Board Operation Figures

The Nautical Gazette, 20 February, 1926.—There are grounds for encouragement in the fact that the Shipping Board's operating accounts are showing improvements. For the last half of 1925 the cargo vessels operated by the board showed a loss per voyage of $3,000 less than during the fiscal year 1925 and more than $10,000 less than during the fiscal year 1924. A long way remains to be traversed before the operating losses are wiped out altogether as the average loss during the last half of 1925 amounted to $16,600 per voyage. This is a heavy deficit and some sharp slashing in

operating costs and substantial increases in revenue will have to be made before the balance is on the other side of the ledger, but even this improvement indicates that the board is getting down to a more businesslike basis and that American ships are becoming less of a national liability. Some illuminating figures are contained in the statement submitted by the board to the House appropriations committee during the hearings on the Independent Offices' Appropriation bill when these voyage losses become known. For example, there is a decided significance in the fact that only one service showed a profit during the period, and that was the Pacific, Argentine and Brazil Line which has just been sold to the McCormick Steamship Company of San Francisco. This line showed a profit of $3,784 per voyage or a total profit of $18,921 for the six months. The total loss for the period was computed to be $8,499,239. Some interesting figures regarding the passenger services were also made known. The only passenger service to fall behind its 1924 record in 1925 was the American Oriental Line, the service which R. Stanley Dollar is now trying to purchase. This line made a profit of $939,724 in the fiscal year 1924 but showed a loss of $1,556,227 in the fiscal year 1925. The only passenger service to show a profit in 1925 was the California Orient Line which brought a loss of $46,114 in 1924 up to a profit of $538,075 last year. The United States Line did nothing more than to show a decrease in a heavy loss, the deficit of $3,463,485 in 1924 being reduced to $2,315,863 in 1925. These figures show that the Board is doing good work in its endeavor to reduce the operating losses, but that the day when an all-round profit will be shown is still a long way off.

Another interesting set of figures is those just made public by the Atlantic conference covering passenger traffic in 1925. As might be expected the statistics show that the greater volume of traffic was westbound. The companies carrying the greatest number of passengers on the westbound trip were the Cunard, White Star, and Canadian Pacific, their figures being 109,074, 69,939, and 60,629, respectively. Next in order were the United States Lines with 47,839, and the North German Lloyd with 35,101. Sixth on the list were the Hamburg-American and United American combined lines with 33,368, and the French Line was seventh with 28,604. The Cunard Line alone ran up a total of six figures, their increase over the 1924 total being 16,507 passengers. The North German Lloyd showed the striking increase of 16,065 passengers. The United States Lines showed an increase of 13,820 passengers, the Hamburg-American and United American Lines, 11,507, and the French Line and the White Star about three thousand each. A striking feature of these statistics is that relating to the Canadian Pacific results. This line showed a heavy decrease in 1925 as compared to 1924, the falling off being no less than 24,349 passengers. The figures relating to eastbound traffic show that the Cunard, North German Lloyd, and the Hamburg-American and United American combined services each gained about six thousand passengers in 1925. The United States Lines and French Line showed increases of about 4,500 passengers each. In this traffic both the Canadian Pacific and White Star showed a falling off in 1925, the decreases being 7,161 and 4,636 passengers, respectively. From these figures it will be seen that the United States Lines, while not heading the list, made creditable increases in both eastbound and westbound traffic. It will also be noticed that the German Lines made striking increases, a fact which becomes very significant when it is remembered that in 1920 these companies were practically out of the running and that their showing last year was the result of five years' effort.

MISCELLANEOUS

Liners Beyond Scope of Arms Conference

By Hector C. Bywater, The Baltimore *Sun*, 16 February, 1926.—London, January 29.—From hints which have been lately dropped by American naval writers, it would appear that the question of merchant shipping in relation to combatant strength at sea is to be raised by the United States at the next armament conference.

Captain Dudley Knox, U. S. Navy, has discussed this subject more than once in the columns of *The Sun*, and now a Washington service paper, dealing with the same point, writes: "The stoppage of capital-ship construction would be to the great advantage of Great Britain. Her preponderance in cruiser strength, supplemented by the overwhelming number of fast and serviceable merchant ships she has available, is such that she could readily afford, if other nations would do so, to scrap battleships."

It is certainly true that a nation possessing a large fleet of commercial ships is in a better position to wage war than a country not so well provided with these potential naval auxiliaries. Merchant vessels played a very prominent part in the conduct of the World War. Many of them served as cruisers. The British Tenth Cruiser Squadron which formed the cordon of blockade around the North Sea was composed entirely of armed liners.

Vessels of the same type were used in the earlier stages of the war to patrol the trade routes and it was while engaged in this duty that the *Carmania* fought her famous duel with the German steampship *Cap Trafalgar*. A few merchantmen were converted into aircraft carriers, the most noteworthy of these being the old Cunarder *Campania* and the ex-Italian liner renamed *Argus*. Numerous other ships of the merchant marine were employed with the fleet as depot ships, floating workshops, naval transports, and fleet messengers. There is no doubt that they released for front-line duty a great number of warships proper which would otherwise not have been available.

Good speed is essential in a merchantman earmarked for active naval service. Reference to the shipping lists shows that eighty-five vessels with a speed of twenty knots and upward were afloat last year under various flags and forty-eight of these were British. They ranged from the mighty *Majestic*, of 56,551 tons, to the small but very swift cross-channel steamers which would be useful as scouts or patrols. In the American mercantile marine there are only nine vessels of 20 knots or more.

Closer analysis of the tables reveals the fact that British predominance is greatest in ships of very high speed. Twenty-one vessels are listed as having speeds between 23 and 26½ knots and of this number fifteen are British. There are also twenty-four vessels able to steam at speeds between 21 and 22½ knots and eighteen of them are British. That this large group of high-speed merchantmen constitutes a most valuable asset from the naval point of view is self-evident.

Captain Knox and other American authorities lay particular stress on the utility of such craft as aircraft carriers. It is suggested that in case of emergency Great Britain might commission a whole fleet of swift liners to carry airplanes, and thus render nugatory the ratio in this class prescribed by treaty. The point seems worthy of investigation.

The two essential requirements in an aircraft carrier are high speed and ample dimensions. Twenty-one knots is probably the minimum pace for a carrier intended to work with a battle fleet or cruiser squadron, and if planes are to land on her deck, as well as to fly off, there must be plenty of free deck space for the purpose. Turning to the lists again, it will be found that out of the thirty-three ships which can make 21 knots and upward only six are larger than 4,000 tons, which is probably well below the minimum size necessary for aviation work, if this entails deck-landing operations.

Britain has, therefore, half a dozen merchant vessels which would be adaptable as fast airplane carriers. It may be objected that 21 knots is an arbitrary figure of speed in this connection, seeing that the United States carrier *Langley* is good for only 14½ knots. The fact remains that all modern carriers are designed for very high speed, and no admiral would care to have with his fleet a carried which could not, at the very least, keep up with his slowest battleships. But even if we reduce the minimum to 20 knots, it adds only three large ships to the British total.

It is not my purpose to belittle the advantage which Britain enjoys as a naval power by reason of her splendid mercantile fleet. To do so would be futile. But if the suggestion is that this fleet should be included as a positive factor in computations of naval strength, and be held to represent the equivalent of so much actual fighting tonnage when the time comes to establish new ratios of combatant power, I fear that British naval opinion will express emphatic dissent.

Already the American tentative proposal to this effect has been criticized here as irrelevant and impracticable. If the imponderable elements of war-like strength are to be brought into the discussion, the United States may be reminded that its domestic reserves of oil fuel are worth a great many battleships or cruisers. The Washington Arms Conference was a success because it dealt only with cognate subjects and left extraneous issues severely alone. Unless the same principle is followed at Geneva there will be small hope of fruitful results.

Someone has said that the only way to insure the success of the next conference would be to keep out all the armament experts. There is a grain of truth in this witticism. At Washington the hottest debates occurred on points of technical importance, such as the exact degree of completion of the Japanese battleship *Mutsu*, the manifold variations of warship "displacement," gun calibers and so forth.

The outcome of all this discussion was a treaty which is so much Sanskrit to the layman, and which no naval student of my acquaintance professes to understand in all its clauses. It is full of contradictions, and there are countless loopholes for any party that saw fit to take advantage of them.

One example will suffice here. "Standard displacement" within the meaning of the treaty is displacement exclusive of fuel and reserve feed-water. In the case of a battleship these two items together might account for 5,000 tons, so that a battleship which nominally conformed to the treaty maximum of 35,000 tons might really displace 40,000 tons. Cruisers are restricted to 10,000 tons, but it will be surprising if the true displacement of such ships works out at less than 12,500 tons. As for the passages which define an aircraft carrier, they are simply beyond mortal understanding.

If the forthcoming conference were to adopt the American proposal to treat mercantile ships as prospective war craft and count them in as equal to so much naval tonnage, a highly controversial issue would be imported into the proceedings and the chances of agreement sensibly diminished.

Destroyers

Their Place in the Scheme of Naval Warfare, by Sir Herbert Russell, *The Naval and Military Record*, 27 January, 1926.—The launching of the *Ambuscade* and *Amazon* marked the putting afloat of the only destroyers which have been laid down for the British Navy since the Armistice. A certain number of destroyers which were under construction towards the latter period of hostilities have been completed and passed into service. But the Yarrow and Thornycroft boats are the only post-war contributions to the destroyer strength of the fleet. The newspapers have been able to tell us very little indeed regarding these craft—less, even, than of the *Nelson* and *Rodney*. They suggest novel features of design, based upon the experiences of the Great War. This, of course, is simple conjecture. Before

the war, when Germany was watching with sinister intentions every step in our naval construction, the Admiralty let the taxpayers know just how their money was being spent in such matters as tonnage, guns, speed, armor, fuel capacity, accommodation for complements, and the like. Now that no foreign power is watching out naval progress—at any rate with the least sinister intent—the Admiralty keep as close as an oyster. They call this policy. A good many people will call it by a less dignified word.

In point of fact, I venture to suggest that there is nothing worth concealing in the design of these sister destroyers. The "last words" in details which they embody merely represent the normal progress of development. No new method is materialized in their plans. They stand for exactly the same principle of warfare as did their 300-ton predecessors of a quarter of a century ago, and the question of the size of the torpedo they can fire, the range of the gun they mount, and the rate at which they can travel through the water merely represent the degree of advancement made by the material school, upon which I had something to say last week.

The primary rôle of the destroyer is perfectly simple. She is dedicated to the idea of sinking an enemy ship by torpedo attack. Extreme mobility is the chief qualification for any chance of success. But this first principle in her *raison d'être* has become obscured—or, perhaps, it would be more correct to say complicated—by the process of extending her utility. She is no longer purely a torpedo-boat destroyer; rather she is a miniature light cruiser. That she was put to many purposes during the war may be argued as proof of justification for the extension of her original rôle. But expediency does not justify definite acceptance of compromise. It would be a perfectly sound principle to adapt the destroyer to as wide a range of utility as posible, but for one by no means insignificant objection. As the inevitable issue of such a doctrine she must cease to be a destroyer. In warfare size is her serious disability. The smaller she is the better her chance of delivering her attack, since she presents the minimum target to the enemy gunners.

In saying this I am not overlooking the fact that the destroyer must embody qualities which set a definite minimum to size. First and foremost she wants speed. This means liberal machinery space. But here we come to a question of ratios. The idea that speed demands size is practically an illustration of the precept about "making the meat it feeds upon." The bigger the hull the bigger the machinery must be to drive it. Nearly twenty years ago we were getting 35 knots out of a displacement of about 850 tons (*Tribal* class). Today the big *W* class, ranging between 1,275 and 1,350 tons displacement, are officially given as 34-knot boats. Let us assume they are the equals of the *Tribal* class in speed and that in dirty weather they would probably prove their superiors. Is this an adequate advantage for an increase in size to half as big again?

The answer, of course, will be that they have a considerably bigger sea-keeping endurance. It is not really very much bigger, because although their fuel storage is larger, their fuel consumption is also larger. But let us concede this as a point in their favor. By doing so we come the more easily to the argument that in creating the sea-keeping unit we are destroying the destroyer. We are evolving a ship to do the work which was originally recognized as the metier of a boat. Certain foreign naval powers, more obsessed than ourselves with the fetish of mere size, are constructing destroyers of considerably over 2,000 tons. Twenty years ago such craft would have been classified as very fully-fledged third class cruisers. But they are not cruisers, because, despite their great growth in displacement, they cannot keep the sea long enough to carry out the all-round functions of the cruiser.

Now, I am not attempting to deny that sea-keeping endurance is a very valuable asset. The ideal destroyer is the vessel that can keep company with a battle squadron up to the full limits of cruising radius of the latter.

But she can never be built, because when she is built she is not a destroyer at all within the strict tactical definition of the word. She may be armed with torpedoes that will enable her to deliver an attack at hull-down range from a battleship's deck. If this is to represent her mode of hostilities her extravagant speed becomes unnecessary. The modern light cruiser can do this and keep the sea as well.

The destroyer is regarded as invaluable in commerce protection. She proved herself so during the war. But let there be no mistake about it; the conditions of the Great War will never be repeated. Instead of waiting until enemy submarines had exacted an appalling toll of tonnage from single, undefended ships before doing the obvious thing, as we did in those days, we shall do it right away should there ever be another great naval war. We shall promptly establish convoy and routing. The proportion of our losses from German submarines amongst properly routed convoys forms a lamentable commentary upon the lack of judgment which so long deferred adopting this measure.

Commerce protection is not the direct business of the destroyer. She does not need a speed of 35 knots to escort a cluster of ships at 12 knots. Her sea-keeping limitations render her unsuitable to convoy work, although the moral effect of her high mobility would be considerable upon enemy submarines. Her direct business is torpedo attack against hostile warships. She is a flotilla unit, and as soon as she is segregated from this idea complications of purpose and consequently of design become inevitable. At one time it seemed possible that the submarine would supersede the destroyer. The only factor that has militated against her doing so is her severe restriction of submerged speed. If she could run under water as fast as she does on the surface—that is to say, if she could always be able to attack a battle fleet in action—the destroyer must certainly have given way to her. But as she cannot, and presumably never will, the surface torpedo craft continues to hold her place in the scheme of naval warfare.

The basic principle of naval design is that the combatant ship is a vehicle for certain definite types of weapon. Tactical science determines the question of the best methods of employing the various types of weapon. So long as evolution progresses along the line of ensuring the most effective employment of weapons it remains strictly legitimate. When it ramifies with the idea of extending the scope which tactical principles have set, then we begin to confuse both the end and the means. The naval architect will produce any description of ship he is asked for; it is not his business to decline on the grounds that she is a bad type, or an unnecessary type, for her nominal functions. The destroyer is the vehicle of the torpedo. Her work entails a higher element of risk than that of any other class of warcraft. For this reason it is obviously desirable to split that risk as far as is possible. The largest number of the smallest boats compatible with effective capacity for the fulfilment of their task appears to me the sound doctrine of destroyer construction, and I cannot help thinking that the line of reasoning which has led France, for instance, to design *torpilleurs des haute mer* of considerably more than 2,000 tons is confused and wrong.

One might carry the argument into another field of controversy by raising the question as to whether the torpedo is of very high value as a naval weapon at all. To say that the German U-boat campaign demonstrated its efficacy is a mere fallacy, because not only is the process of choosing a helpless target no proof of the war value of any weapon, but by far the largest proportion of the U-boat victims were sunk by submarine gunfire. All our big warships are fitted with torpedo-tubes, the later groups of light cruisers having as many as twelve apiece. It would be interesting to know what results—if any—were obtained by torpedo delivery from big ships (including light cruisers) during the war. The *Arethusa* certainly put a couple of torpedoes into the sinking *Blucher* at the battle of the Dogger-bank. I do not suggest that there was anything unchivalrous in this *coup*

de grace, but the *Blucher* was mortally wounded and fast settling to her doom before the torpedoes were fired.

History travels in cycles—particularly naval history. In 1885-86 Admiral Aube, French Minister of Marine, was demonstrating the impotence of the ironclad against the torpedo-boat with such vigor that in the debate on the British Navy Estimates for 1886-87 Mr. Shaw Lefevre moved "that the construction of the battleships *Nile* and *Trafalgar* should be suspended," and was supported by several naval officers in the House. Mr. Hibbert, then Secretary to the Admiralty, successfully opposed the motion, but in the course of his speech frankly admitted his belief that these were the last two ironclads that would be built owing to the new method of warfare.

It is instructive to turn to the record of Japanese destroyer attacks during the war with Russia and to ask the question whether they could have done more than they did, and better than they did, if, instead of boats of 350 tons, they had possessed destroyers of 1,350 tons. I think it quite possible they would have accomplished less, because, naturally, they would have been rather more chary in risking craft of four times the size, and these craft might not have been able to get where the smaller ones penetrated.

The very fact that the Admiralty have only laid down two destroyers in the past seven years suggests a good deal of hard thinking upon these points. Nor must the *Ambuscade* and the *Amazon* be taken as materializing the conclusions of this hard thinking, since they were actually planned in 1920. I do not profess to know what is at the back of the policy under which a considerable number of destroyers, ranging between 950 and 1,050 tons, of 36 knots speed, built towards the end of the war and but very little used since, are being "scrapped." Is it merely a question of economy? If so, how does this reconcile with the program under which twenty-seven new destroyers are to be laid down between now and 1932? Since a large proportion of these condemned destroyers are still perfectly effective, it is not unreasonable to assume that they are being condemned in accordance with a new tactical conception of destroyer functions.

Offers of Further Arms Limitation Should Come from the Foreign Naval Powers

The Washington *Star*, 24 January, 1926.—A vastly different situation faces the United States on the eve of the proposed conference for the further limitation of naval armaments from that which obtained in the winter of 1921-22, when the Washington Conference took place.

Four years ago the United States was on the way rapidly to become the greatest naval power the world had ever seen. It had but to complete the program it had laid down for the construction of capital ships—a program which no other nation could have hoped successfully to equal within the same time.

Today this superiority is gone. Capital ships and aircraft carriers have been limited by the Washington Treaty. The ratio is 5—5—3—1.67—1.67 for the treaty powers—the United States, Great Britain, Japan, France, and Italy, in the order named.

Today the United States finds that in the matter of so-called auxiliary craft, except destroyers and first-line submarines, none of which is limited by the treaty, it is far below the ratio established for naval strength at the Washington Conference. The United States finds that in the matter of modern cruisers, from 3,000 to 10,000 tons and carrying 5-inch to 8-inch guns, and in the matter of fleet submarines, Great Britain and Japan are both ahead of her.

And as a matter of fact, even in capital ships and aircraft carriers, which are limited by the Washington Treaty, the United States does not have the full ratio strength permitted her.

Furthermore, the other treaty powers are engaged in building programs today which far outstrip the programs of the United States with regard to the craft not limited by the treaty.

In 1921 the United States was in a position to be generous and to give. In 1926 the United States is in a position to receive and to be the recipient of generosity.

Indeed, it is time for the United States to seek further limitation of naval armaments, covering the craft not included in the Washington Treaty, or to jump into the naval construction race.

The preliminary conference on limitation of armaments which will frame the program for the conference proper is now expected in April. At the request of the President, Congress is in the process of appropriating $50,000 for America's representatives at this preliminary conference.

America's representatives at the conference doubtless will demand that in naval limitation the ratio for naval strength, as reflected in the agreement on capital ships, shall be the ratio adopted for the auxiliary craft. This country was most anxious in 1921 to have the treaty then made cover all kinds of naval craft as well as capital ships and aircraft carriers. Had this been done, the problem of limitation of naval armament would not today be awaiting solution.

In demanding equal strength with any naval power in the world and greater strength than many of the powers, the United States is guided by the needs of national defense and the requirements to give adequate protection to American commerce and Americans throughout the world. This country has a vast coast-line and far-lying possessions, including the Panama Canal, which must be protected. It has a foreign commerce today which is greater than that of any other nation.

Great Britain and Japan have retained their advantage in auxiliary craft, while the United States has given up its former advantage in capital ships. Not only have these two sea powers retained this strength, but they have increased and are increasing it. It is perfectly true, however, that the Washington Treaty made no limitation with regard to auxiliary craft, and those other nations have acted entirely within their rights in building more such craft. The United States has either been negligent or has waited, hoping for a further conference in which limitation of all naval craft might be agreed to.

Because of the situation now existing from the American point of view, Washington is not the place for the coming naval conference. Let the other countries play the host, since the host must make the proposal of sacrifice. The United States has nothing to offer along this line, and if compelled to play the host would be in the sorry position of asking its guests to be generous and to give up part of their naval strength.

The suggestion has emanated from some quarters that the proposed arms conference be divided, with a naval conference in Washington and the conference on land armaments in Europe. But this does not seem a sound proposition for the reasons already given.

Cold figures tell the tale of present naval strength graphically. First, take the capital ships and the aircraft carriers, limited by treaty. The United States has today eighteen capital ships of 528,850 tons; Great Britain, twenty-two capital ships of 580,450 tonnage (four of the older ships are to be scrapped when two new ones are completed this year); Japan, ten capital ships of 301,320 tonnage; France, nine capital ships of 194,544 tonnage, and Italy, seven capital ships of 133,670 tonnage. Replacements in the course of time will bring the powers more nearly to the actual ratio established in the treaty. In the matter of caliber of guns, the British and Japanese have the advantage to some degree over the United States, for fourteen American capital ships are armed with 13.4-inch guns or heavier, while four are armed with 12-inch guns; twenty British ships are armed with 13.4-inch guns or heavier, and ten Japanese.

Under the Washington Treaty, the ratio of aircraft carrier tonnage was fixed as follows: United States, 135,000 tons; Great Britain, 135,000; Japan, 81,000; France, 60,000, and Italy, 60,000. Aircraft carriers are still in the experimental stage, and all those now built are regarded as experimental except the British carrier *Furious,* completed last year, a vessel of 19,000 tons. The United States today has one carrier, 12,700 tons, and two building, the *Lexington* and *Saratoga,* which were building as battle cruisers when the Washington Treaty was negotiated. They will add 66,000 tons to America's aircraft tonnage. The British Empire today has four aircraft carriers of 67,290 total tonnage, and two building with a total tonnage of 37,200 tons; Japan has one aircraft carrier of 9,500 tons, and two building of 53,800 total tonnage; France is building one carrier, or is, rather, converting a battleship, *Bearn,* into a carrier of 21,600 tonnage; Italy has no aircraft carriers and is not at present building any.

The actual ratio of aircraft carriers built and building today is: United States, 2.91; British Empire, 3.87; Japanese Empire, 2.35; France, .78, and Italy, none.

Taking up the unlimited craft, it is found that the present strength of the powers in modern cruisers is as follows: United States, ten of 75,000 total tonnage, and two building of 20,000 total tonnage, making in all 95,000 tons; the British Empire has thirty-eight of 179,190 total tonnage, and thirteen building of 125,100 total tonnage (two of these are 10,000-ton cruisers for Australia), making in all 304,290 tons; Japan has sixteen of 82,210 total tonnage, and nine building of 73,995 total tonnage, making in all 156,205 tons; France has three of 16,734 total tonnage, and six building of 53,619 total tonnage, making in all 70,353; Italy has eight of 30,784 total tonnage and two building of 20,000 total tonnage, making in all 50,784 tons.

The actual ratio of modern cruisers according to tonnage is as follows: United States, 1.56; British Empire 5; Japan, 2.57; France, 1.15, and Italy, .83, which is very different from the naval strength ratio established at Washington.

In the matter of destroyers the United States fares much better, although only 106, and six mine layers are kept in commission. The rest of the American destroyers are laid up. The American destroyers were built for the most part during the World War. The United States has no "leaders," but has 281 destroyers of 334,688 total tonnage, and none building; the British Empire has eighteen leaders of 31,310 total tonnage, 183 destroyers of 209,265 total tonnage, and two destroyers building of 2,700 total tonnage; Japan has no leaders, but has seventy-two destroyers of 77,025 total tonnage, and is building twenty destroyers of 28,855 total tonnage; France has one leader of 2,067 tons, nineteen destroyers of 18,628 total tonnage, and is building six leaders of 14,154 total tonnage and eighteen destroyers of 26,034 total tonnage; Italy has eight leaders of 14,889 total tonnage, and twenty-two destroyers of 18,839 total tonnage, and is building twenty-five destroyers of 26,622 total tonnage.

The actual ratio of modern type destroyers according to tonnage is as follows: United States, 6.88; British Empire, 5; Japan, 2.18; France, 1.25; Italy, 1.24.

In the matter of fleet submarines, the United States has five of 7,556 total tonnage and is building four; the British Empire has eight of 16,460 total tonnage, and is building three of 4,400 total tonnage (two being for Australia); Japan has two of 2,800 total tonnage, and is building eighteen of 26,280 total tonnage; France has none, but is building two of 6,000 total tonnage; Italy has none, but is building four of 5,200 total tonnage.

The ratio of fleet submarines according to tonnage is as follows: United States, 3.72; British Empire, 5; Japan, 6.96; France, 1.43, and Italy, 1.24.

Submarines of the first line are as follows: United States, fifty of a total tonnage of 43,822, none building; British Empire, twenty-six of

23,560 total tonnage, and two building of 1,780 total tonnage; Japan, forty-one of 32,838 total tonnage, and four building of 3,659 total tonnage; France, fifteen of 12,993 total tonnage, and eighteen building of 13,281 total tonnage; Italy, ten of 7,902 total tonnage and eight building of 6,340 total tonnage.

The first line submarine ratio according to tonnage is as follows: United States, 8.64; British Empire, 5; Japan, 7.20; France, 5.18, and Italy, 2.81.

The airplane-carrying capacity of the various fleets may be described as follows: United States, 252; British Empire, 468; Japanese Empire, 230; France, 111, and Italy, 34. The ratio is as follows: United States, 2.69; British Empire, 5; Japan, 2.46; France, 1.19, and Italy, .36. This capacity includes carriers, battleships, and cruisers.

In the matter of planes and aircraft personnel, the United States Navy has 218 planes in commission and 180 in reserve; 709 officers and 4,537 enlisted men. The British Navy has 116 planes in commission and 100 per cent in reserve, but it has 544 additional planes in general service in the royal air force.

There is no official data from Japan on this subject but the best available shows that the Japanese Navy has 148 planes in commission and 305 in reserve, and 400 officers and 3,500 enlisted men; the French Navy has 84 planes in commission and 96 in reserve, and 210 officers and 3,500 enlisted men; Italy has her planes in general army and navy service, having 605 planes in commission and 467 in reserve.

In personnel strength the navies of the five powers show up as follows: United States, 8,312 officers and 81,702 enlisted men; British Empire, 8,846 officers and 95,922 enlisted men (Including 357 officers and 2,480 men of the royal air force performing naval aviation duties): Japan, 7,143 officers and 65,412 enlisted men; France, 3,493 officers and 50,487 enlisted men; Italy, 2,233 officers and 40,881 enlisted men.

The actual ratio as applied to officers and men is as follows, the first figure, being for the officers: United States, 4.69 and 4.26; British Empire, 5 and 5; Japan, 4.26 and 3.41; France, 1.97 and 2.63; Italy, 1.26 and 2.13.

The navy vessels laid down or appropriated for since February 6, 1922, the date of the close of the Washington Conference by the five powers are as follows: United States, a total of thirteen; British Empire, twenty-six; Japan, ninety-six; France, seventy-one; and Italy, forty-three. These figures cover all kinds of craft, and show that the United States has been lagging, while others hurried ahead. The British Empire has a five-year building program, calling for nine 10,000-ton cruisers, seven 8,000-ton cruisers, twenty-seven first line destroyers, twenty-four fleet submarines, five gunboats, four patrol vessels, two submarine tenders, one repair ship, and one net layer.

The Japanese Navy also has a five-year building program, although this may be cut by the government because of a financial depression in Japan. It follows: four 10,000 cruisers, twenty 1,500-ton destroyers, ten 1,500-ton fleet submarines, three gunboats, one aircraft tender and two special service ships; France, five-year building program includes three light cruisers, eighteen first line destroyers, fifteen destroyers leaders, two mine layers, two fleet submarines, twenty-one first line submarines, six first line mine layers, four oil tankers, and one submarine tender.

Italy has under consideration the following building program: three light cruisers, eight first line destroyers, and eight submarines.

Already it has been clearly intimated that the British at the coming naval limitation conference will strongly urge the abolition of the submarine entirely. Indeed, she sought such action at the Washington Conference, but was blocked by France, which, however, was seconded by the United States, Japan, and Italy in this opposition. The British have much to gain by the abolition of the submarine. The United States, however, because of its great coastline, needs the submarine for defensive purposes.

Another proposal which the British are expected to put forward is the abolition of the capital ship—that there shall be no replacement under the Washington Treaty. If this course were followed, it is easy to see from the figures already given that Britain would be left supreme on the sea, since she is stronger than any other nation in the matter of cruisers, aircraft carriers, and fast merchant vessels capable of being converted into cruisers, and Japan would be second in strength in this next most powerful type of naval vessel. The United States would be third.

A third proposal advanced from British sources is that cruisers be limited to 6,000 tons, with 6-inch guns. Under the existing navies, this would leave the United States with none of these vessels and none buildings; Great Britain with thirty-four and Japan with sixteen and one building.

Another factor of tremendous importance, which doubtless will be considered is the base. Fortified naval bases are important in naval strategy. Outside of the Panama Canal Zone, which is now used only as a commercial base, this country has but one fortified base that is not in continental United States, and that is Pearl Harbor, near Honolulu. The Washington Treaty prevents further fortification of our other insular possessions in the Pacific. This lack of bases and the need of protecting the Philippine Islands are additional reasons why the United States needs submarines for defensive purposes.

Great Britain has a chain of fortified naval bases that extend from Gibraltar to the Far East. She holds islands in close proximity to the United States, and in any agreement that may be reached at the coming conference, it would be the part of wisdom to provide that she should not increase her fortification of these islands.

Japan, whose interests lie principally in the Far East, has ample bases on her mainland, and some of her island possessions were strongly fortified before the Washington Conference.

Short Waves

Navy Tests Reveal Value of Channels under 80 meters, "Skip Effect," Which Forces Washington to Talk With St. Paul via London is Puzzle—Amateurs Active in Research, New York *Times*, 28 February, 1926.—The American amateurs, many of them boys in high school, operating home-made short-wave transmitting sets in the attics of their homes, opened the eyes of the world to the possibilities of short wave lengths in bridging long distances with a ridiculously small amount of power, according to Lieutenant Commander A. H. Taylor, Chief of the United States Naval Research Laboratory.

"The behavior of the waves in the neighborhood of 100 meters was a distinct reversal of form and exactly the opposite of what would have been expected by every one familiar with the developments in the longer wave lengths. Instead of signals being of less intensity than those sent out on 200 meters with the same power, they were of much greater intensity, and instead of being more unreliable they were a great deal more dependable," said Lieutenant Commander Taylor in an interview last week.

"The development has been extremely rapid, and in this new field the technical staff of the Naval Research Laboratory, located in the southern end of the District of Columbia, has played an important part. For more than a year one of the transmitters built at this laboratory and placed at the disposal of the Navy Department during the night hours has carried almost the entire night load of our high-powered station at Annapolis, which has resulted not only in the saving of a considerable sum of money for the Navy, but has relieved broadcast listeners in Baltimore, Washington, and Annapolis of the extremely disagreeable interference which ema-

nated from the high-power, long-wave station at Annapolis," said Commander Taylor.

He pointed out that in the early days of wireless the amateurs operated on a great variety of wave lengths, but they were restricted when government regulations finally stepped in to avoid interference. Operating in the 200-meter band, the amateur stations of five to ten years ago established many remarkable long distance transmission records, but it was found upon analysis of these records that very few transmissions were recorded for distances over 150 miles by daylight and that the nocturnal transmissions were extremely erratic and unreliable. Indeed, they were so uncertain that the military and commercial interests of this country were well satisfied that they were not in this wave band.

For a number of years no one thought seriously of attempting long-range experiments on still shorter waves, because as one studies the behavior of transmissions from 15,000 meters down to 200 meters, it is easy to see that the daylight ranges rapidly decrease and that the night ranges become more and more erratic and unreliable. However, the amateurs of this country made a strenuous and concerted effort to get signals from this country into Europe with low power transmitters operating in the 200-meter band, but the experiments were attended only with a very limited amount of success.

"Somewhat later experiments were undertaken in the neighborhood of 105-110 meters, which showed entirely different results," said Mr. Taylor. "The experiments by American amateurs are of particular interest, because they were carried out, in most cases, with less power in the transmitting antenna than would be required to operate an ordinary electric flatiron, and yet several of them were able to put signals into Europe consistently for a good many hours at a time and for many nights in succession."

Commander Taylor explained that waves much shorter than fourteen meters will not likely be of much use for long distance work. Even in the band between twenty and forty meters, a new phenomenon occurs which is called the "skip effect."

"It is now definitely known that the wave directly radiated from the antenna and spread out over the ground in the usual manner is very quickly absorbed and is of no use in long distance work. On other hand, the portion of the rays which radiate toward the sky from the antenna are refracted from an ionized region whose height varies from 50 to 700 miles, according to the time of the year and time of the day, and these rays coming down to earth again after a considerable distance are the ones which are valuable in communication," said Commander Taylor.

"Under certain conditions, when operating in the band from twenty to forty meters, stations at relatively nearby points, that is, a few hundred miles away, will be skipped over or missed entirely, whereas intense signals will be received much further on.

"I can recall an occasion when I was in communication on the twenty-meter band with a British station between twelve and one in the afternoon; at the same time, two American amateurs, one in St. Paul, Minnesota, and one in Connecticut, were listening in on the test. The only way I could communicate with the man in Connecticut was to relay a message either through St. Paul or through London. He was unable to hear my signals, and I was unable to hear his. On the other hand, I was perfectly well able to work London. The St. Paul man on the other hand, being outside the skip distance which at that time of the year was about 600 miles for that wave, was able to communicate with everybody.

"Now during the night hours the skip distance is very great. I have communicated directly with Sydney, Australia, in the twenty-meter wave band without having my signals heard anywhere in the United States out-

side of eight or ten miles which would be penetrated by my rapidly absorbed ground wave.

"It is a common experience at this time of the year when operating in the forty-meter band to notice that as the ionized layer of the earth's atmosphere rises to high altitudes after sunset, the skip distance is increased so that the New England stations become gradually weaker as the night hours wear on and disappear at Washington, but at the same time European stations working in this band and our Mid-West and West coast stations, to say nothing of New Zealand and Australia, come in very well, indeed. It is due to the use of the 'sky wave,' which passes through a medium not capable of absorbing it, that such immense distances can be covered with such a small amount of power. Communication between the United States and Australia has been maintained on a number of occasions by American amateurs using only a few watts; in other words, much less power than is required to light a twenty-five-watt electric lamp. I do not say that communication was fully relibale with such power, but nevertheless a number of messages have been thus exchanged.

"Another very interesting thing has come out of the short wave development, and that is, that it is entirely possible to receive a radio signal on short waves over greater distance than one half around the world. Knowing the properties of these waves, we can definitely say, if Johannesburg, South Africa, hears one of our West coast stations at a time of the day when there is nine hours of daylight between that station and Johannesburg, that a forty-meter wave could not possibly have traveled such a distance during daylight; therefore, it must have gone the other way around the world, namely, a distance of 16,000 miles.

The Discovery of Electrons

By Professor Peter I. Wold, Head of Physics Department of Union College, *The Radian*, February, 1926.—What *is* the electron? The scientist looks upon the electron as a small charge of negative electricity, the smallest charge of electricity which can exist, and as an essential part of the atoms which make up matter as we know it.

There is rarely an important scientific discovery which is not preceded by closely related work which forms its foundation. The discovery of the electron is no exception to this. In fact, it may be said to be the culmination of a century of work in the electrical field. Of the numerous contributors I would make mention of that prime prince of experimental scientists, Michael Faraday. In addition to his many other important contributions to science, Faraday, about ninety years ago, discovered the laws of electrolysis, which are used in electroplating and in other work. You will recall that if two metal plates are inserted in a solution of certain chemical compounds, and an electric current is passed between them, certain materials are deposited on the plates. The explanation usually given is that in solution the chemical compound is dissociated or broken up into positively and negatively charged ions. If, for example, we make a solution of hydrochloric acid there will be present hydrogen ions each carrying a plus charge and chlorine ions each carrying a minus charge. The positive ions will travel towards one mental plate and the negative ions towards the other plate. Now the smallest charge which any ion has been found to carry is that for the hydrogen ion, and all other ions are found to have the same charge or an exact multiple of it. This immediately suggests that the hydrogen charge is a natural unit of electricity, and that all charges are whole multiples of this unit. At the same time, the hydrogen ion or atom is the lightest one we know of—*i.e.*, has the smallest mass and so the ratio of the hydrogen atomic charge to the hydrogen atomic mass is of special interest since it will be larger than for any other element.

I must call your attention to another class of phenomena, which was studied extensively during the century preceding the discovery of the electron. You know that air and other gases are very poor conductors of electricity. At atmospheric pressure in air we get only a violent or disruptive discharge as in lightning, but if the pressure is reduced to one-third or less the discharge becomes continuous and takes on a color and form dependent on the gas used and the pressure. The effects produced are frequently exceedingly beautiful, but complex. Many scientists worked on these phenomena in attempts to find an explanation for them, but for many decades they defied the efforts of the ablest minds.

In the course of the investigations, it was found that the electric current was due to small electrified particles, some of which carried plus charges and some negative charges. It was generally accepted that these particles were some form of matter, but it could not be said whether they were atoms or things larger than atoms. Very few had the boldness to suggest that they might be smaller than atoms. One of the characteristic effects produced by such a discharge was that of fluorescence—*i.e.*, when these particles, especially the minus ones, struck certain substances, they caused them to give off a beautiful light known as fluorescence.

About 1897, J. J. Thomson of Cambridge University, England, undertook some work on the problem. One of his experiments may be briefly as follows:

He made a glass tube with a metal electrode at each end and pumped out most of the gas. He then connected one electrode to the plus end of an electric generator and the other electrode to the minus end. An electric discharge now took place consisting, presumably, of a stream of plus carriers traveling towards the minus electrode, and minus carriers traveling towards the plus electrode. A small hole in the plus electrode permitted some of the minus carriers to pass through and then traveled in a narrow stream to a fluorescent surface, making a bright spot of light. On two sides of this stream were placed metal plates which could be charged. The negative particles would be attracted sidewise towards one of these plates, and so the position of impact on the fluorescent surface would be changed. The amount of deflection of the spot of light depended on the charge of the particle, on its mass and on its velocity, all of which were unknown.

By performing a similar experiment, using, however, a magnetic field to deflect the negative particles, it was possible for Thomson to find the velocity of the particles and it came out to be in the neighborhood of twenty to fifty thousand miles per second, depending on the voltages used in the tube. This is much higher than had ever been found for any atoms, even hydrogen, which is the lightest. Professor Thomson was also able to find the ratio of the charge of the particles to their mass, but was not able at that time to find these two separately. The value obtained for this ratio was highly surprising, for it came out about 1,800 times larger than the value I spoke of for hydrogen atoms by electrolysis.

Now there are only two conclusions to be drawn from this. Either the charge on the particles—or corpuscles, as Thomson called them—is 1,800 times as large as on the hydrogen atom, the mass being about the same, or the mass of the corpuscles is 1,800 times smaller than for the hydrogen atom. The former conclusion did not seem probable in view of the experiments in electrolysis of solutions. On the other hand, it was difficult for many scientists to think there were particles of smaller mass than the hydrogen atom. Thomson tried the experiment on many different gases, and with different metal electrodes in the tube with the amazing result that this ratio came out the same in all cases. While it was not possible at the time to find the charge on the corpuscle alone or to find the mass alone, and so definitely show which conclusion was right, the prevailing

opinion was that the particles carried the same charge as the hydrogen atom and were of a much smaller mass.

Since they could be obtained from any substance, it indicated very definitely that the atoms of different elements, which formerly had been considered indivisible, were actually complex systems and could be subdivided. This indication has been amply verified since then and has been the starting point of much of the wonderful scientific progress of the past two decades.

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NOTES ON INTERNATIONAL AFFAIRS

FROM FEBRUARY 3 TO MARCH 3

PREPARED BY
PROFESSOR ALLAN WESCOTT, U. S. NAVAL ACADEMY

GERMANY AND THE LEAGUE OF NATIONS

SPECIAL SESSION OF ASSEMBLY.—Germany's application for admission to the League of Nations was received at Geneva on February 10. The application made no conditions, but referred to the interpretations of Article 16 of the League Convenant which were made by the singers of the Locarno Agreement, to the effect that each state in the League might be called upon for military aid in a manner "compatible with its military and geographical situation."

A special session of the League Assembly was set for March 8, to act on the German application.

SEATS IN LEAGUE COUNCIL.—Prior to the entrance of Germany into the League of Nations, there were four permanent members of the League Council (Great Britain, France, Italy, and Japan), and six other members were elected from year to year.

In view of the promise to Germany of a permanent seat in the Council, the question arose as to whether other nations should not be given permanent membership. Spain, Brazil, and Poland each advanced its claims, and it was proposed that one permanent seat should be shared by the nations in the Little Entente. France and Italy, as well as the Little Entente states, were favorable to the claims of Poland, since her admission to permanent membership would counterbalance that of Germany. On the other hand, Germany, as well as Sweden, Norway, and Denmark, were strongly opposed to the admission of any other state besides Germany at this time. The final decision appeared to depend largely upon the attitude of Great Britain; and although the Foreign Minister, Sir Austen Chamberlain had given some support to the French thesis in favor of Poland, the Cabinet was divided on the subject and both parliamentary and public opinion were strongly opposed. It was argued that additional admissions would tend to divide the Council into two factions.

British opponents of the Polish claim are now rallying under the leadership of Lord Cecil (the former Lord Robert Cecil), who is Sir Austen's co-delegate at Geneva and frequently has represented Great Britain on the League Council. Their press support was impressively strengthened today by the editorial in the *Times* discussing the proposed increase in membership of the Council.

"The country is obviously uneasy," the *Times* said. "Why this haste and precipitancy? A really astonishing thing in all this controversy is that for once and almost for the first time in all these difficult years British opinion is emphatically and explicitly united. It is not going too far to say that the country, which, after the confusion of the war period and the jangle of the half-intelligible post-war diplomacy, had begun under the influence of the Locarno principles to follow moral instincts with greater confidence was definitely shocked by this unexpected proposal to reduce to terms of ordinary diplomatic bargaining an occasion that ought to have been an undarkened symbol of European reconciliation.—*Baltimore Sun*, February 28.

SOVIET REPUBLIC

Economic Recovery.—In the series of articles by leading statesmen on "Our New World" appearing in the London *Post* and New York *Times*, Christian Rakovsky, Russian Ambassador to France, on February 19-21, presented interesting information regarding the economic recovery of the territory under Soviet rule.

According to his figures, the capital invested in State controlled industries and railroads amounts to 12 billion roubles, of which the railroads represnt nearly half. Cooperatives control about half a billion roubles; and capital in the hands of private citizens and especially peasants does not exceed 7½ billion roubles, exclusive of the value of land.

Production by state controlled industry in 1923-24 amounted to 66 per cent of the total, and in 1924-25 had increased to 79 per cent. In 1924-25 the total of agricultural and industrial production had risen to 71 per cent of 1913 figures. M. Rakovsky declared that with economic stabilization there had come a lessening of Bolshevik propaganda, and he expressed hope for economic and political understandings with both France and England.

Commenting on these figures, Mr. Walter Duranty in the New York *Times* was disposed to accept the statements made, but pointed out that most of the economic progress thus far has been the product of the peasant masses who form upwards of 90 per cent of the population. What the peasants want is cheap manufactured articles. The Soviet rulers cannot supply these without capital to establish factories, or capital to make purchases abroad.

The early economic recovery of Russia will depend largely, therefore, upon her securing foreign credits, and in Mr. Duranty's opinion the Soviet Government is now willing to admit not only the principle of recognition of state debts but also the right of foreign nationals to compensation for injuries suffered by the revolution, provided ample credits are granted in return.

Franco-Russian Debt Negotiations.—Franco-Russian debt discussions were reopened in Paris on February 24. From the statement of the Russian representative, M. Rakovsky, it appeared that the Soviet Government was willing to give considerable recognition to public and private claims, and would pay high interest on new credits. The debt to France amounts roughly to three billion dollars, of which two-thirds represent pre-

war government and municipal loans, 10 per cent industrial loans, and 20 per cent war loans.

ITALY

CHALLENGE TO GERMANY OVER TYROL.—In a fiery speech before the Italian chamber early in February Premier Mussolini declared that Italy would not tolerate German interference with measures taken to "Italianize" the population of the Tyrol. Italy he declared, was "ready to carry her banners beyond the present frontiers, but back, never!"

The Tyrol territory known as the Upper Adige was ceded to Italy by Austria after the war, and is inhabited by German-speaking people who, though not pro-German, wish to preserve their language and customs. Italy has forbidden the use of German in schools, on street signs, etc., has introduced many Italian families, and has even forced the Tyrolese to translate their names into Italian. Although Austrian territory separates Tyrol from Germany, nationalists in Bavaria especially have expressed sympathy for the Tyrolese, and the Bavarian premier in a speech before the Bavarian Diet declared that Germans should do all in their power to extend aid.

In reply to Mussolini's speech, Foreign Minister Stresemann declared in the Reichstag on February 9 that while Germany accepted the boundaries fixed by the peace treaty, Germany would not permit herself to be hindered by "silly threats" from demanding just treatment for German minorities under foreign sovereignty. He hoped that Germany as a member of the League would have an opportunity to protest against such "insulting remarks."

In a second speech of February 10, M. Mussolini pointed out that German racial minorities on the Upper Adige were not among those for which special provisions were made in the peace treaties, and that Italy would never consent to have the question taken up by the League or other outside assembly.

LATIN UNITY AGAINST GERMANY.—In the course of an interview with a French journalist on February 26, Premier Mussolini advocated Franco-Italian solidarity.

The possibility of common danger, said Mussolini, should increasingly bring together France and Italy, who were not divided by any serious question and who, between them, represented 80,000,000 inhabitants, as many as the Germanic bloc. He called them the balance of masses. If that balance were maintained, he said, the peace of Europe would not be disturbed.

There were in Europe three counter-balancing masses of different races, Latin, Germanic, and Slav, he continued, and the latter two were separated by Poland. If the Latin mass was weakened or split, the balance disappeared.

In this connection, Mussolini said he supported the proposed admission of Poland to the Council of the League of Nations as a permanent member. She ought to enter at the same time as Germany and not later.

POPE REJECTS OVERTURES.—In a letter to the Papal Secretary on February 22, the Pope declared that recent measures of the Mussolini government, in righting the wrongs of former governments toward the church, "must not be interpreted to mean that the Vatican has modified its attitude toward the situation wherein it finds itself in Rome since the fall of temporal power in 1870."

The letter was occasioned by the fact that several churchmen, with the consent of their superiors, had collaborated with a ministerial commission in drawing up new ecclesiastical legislation favorable to the church, and that these were about to be presented to the chamber.

The Pope's letter was variously interpreted as a definite rejection of government overtures, or as an invitation to further concessions.

NEAR EAST

GREAT BRITAIN RATIFIES IRAK TREATY.—The British House of Commons on February 18 ratified the Irak Treaty by which Great Britain continues her mandate over Irak for the next twenty-five years. Foreign Secretary Chamberlain stated at the time that negotiations were in progress between Great Britain and Turkey for final agreement about the Mosul area. In refuting the accusation that the British Government's policy was controlled by oil interests, he said that Turkey had been willing, in exchange for sovereignty over the Mosul area, to grant British firms full concessions throughout the district.

FAR EAST

MANCHURIAN AUTONOMY.—The most significant news from China in February was of a conference of delegates from the three provinces of Manchuria held at Mukden on February 16, at which it was decided that Manchuria must continue quite autonomous, until Peking had established a strong government. This apparently meant that foreign nations, and especially the Soviet government, must deal directly with the Manchurian government under Chang Tso-lin, and that Chang Tso-lin would recognize no orders from Peking.

At Peking the government was reported completely destitute of funds. Railway traffic was paralyzed. The National Armies were threatened by the advance of Wu Pei-fu's forces from the south, and also by aggressive moves of Chang's armies on the Manchurian border.

JAPANESE VIEW OF CHINA'S FUTURE.—In his article on "Japan's Rôle in the World's Destiny" in the New York *Times* of February 15, Baron Matsui, former Japanese Foreign Minister, expressed his opinion that the sure and only solution of China's difficulties will be the coming of a "strong man."

The present trouble in China, whatever the peculiar complications in this instance, is not an isolated phenomenon in the history of that country. It is a phase in a vicious circle which has repeated itself again and again in the past from time immemorial. China needs a strong man; no other

government has been found possible in a country where distances are so vast and conditions and people so diverse.

The kind of chaos we see at present has always occurred in intervals between the emergence of strong men. Yet it is remarkable to observe that the country has after long years of disturbance always come out in the end as a united whole embracing all sections of that peaceful and industrious people. How long it will be before a single man can again achieve unquestioned supremacy none can foretell; while any other solution, such as federation of the provinces, seems equally impossible of realization.

Meanwhile I hardly know what line the powers can adopt in their own best interests and China's. The suggestion has been put forward of joint control over certain departments of Chinese administration, such as finance, communications etc. Such an idea is, however, repugnant to the Chinese, especially now that their self-consciousness has become more pronounced. The powers were all agreed at the Washington Conference to do their best to assist China in her work of salvation. It is certainly incumbent upon them to unite in a common policy and Japan certainly means to co-operate loyally in their deliberations. But that necessary assistance on the part of the powers can only be effectively rendered on condition that China herself is ready to collaborate in earnest.

Further, the magnitude of the interest at stake is not equally distributed between the powers. Multiplicity of counsel is apt to produce weakness in action, and whereas the advantage of one is the advantage of all the losses of some may be greater than the losses of others. Execution of a common policy alike beneficial to China and to the powers is not an easy undertaking. But solidarity of the powers having the larger interests is the indispensable basis of any solution which shall adequately guarantee the interests not only of those powers themselves but of all who desire orderly intercourse with China.

Great Britain and Japan have an ample field in which they may fruitfully collaborate. Both have immense interests in the Far East generally, interests which in no way clash at present and in which Japan discerns no occasion for a clash in the future. Japan heartily welcomes the cordial relations which exist between the two countries and sees in their continued unity the surest guarantee of lasting peace in that quarter of the globe.

UNITED STATES AND MEXICO

Deadlock Over Oil and Land Laws—In February Mexico sent replies to the United States and also to Great Britain, in answer to protests against the retroactive effect of her new land and petroleum legislation against alien ownership. According to press reports the Mexican position was not modified, and the deadlock appeared complete. It was announced on February 27, however, that Secretary Kellogg had decided to continue negotiations and would reply to the Mexican note.

In the meantime Colonel Henry M. Anderson, United States delegate before the Special Claims Commission charged with adjusting claims of United States citizens arising out of revolutionary disturbances in Mexico since 1910, left Mexico City for Washington on February 8. He declared that the Mexican Government, by its attitude before the commission, had completely repudiated the agreement made with the United States in 1924, by which the claims were to be settled.

Seizure of Church Property.—The new Mexican constitution authorizes the taking over of church property by the state, and requires that all priests and clergymen shall be native-born Mexicans. In February the Mexican Government began to put these policies into execution. Several priests, chiefly of Spanish birth, were deported or arrested. It was reported that some Catholic schools, owned and operated by United States citizens, had been closed.

As a result of the situation in Mexico, action on the extradition treaty with Mexico, which was before the United States Senate, was indefinitely postponed. Moreover the deportation proceedings against the Mexican General Francisco Coss, now imprisoned at San Antonio, were postponed for a year. It was believed that Colonel Torres, the officer who was handed over to the Mexican Government at Laredo on assurance that he would be granted a civil trial, had been later shot by a firing squad as a political offender.

BOOK REVIEWS

BOOK DEPARTMENT

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THE LIFE AND LETTERS OF REAR ADMIRAL STEPHEN B. LUCE, U. S. NAVY, By Rear Admiral Albert Gleaves, U. S. Navy. G. P. Putnam's Sons. New York. London. $4.00.

REVIEWED BY CAPTAIN HARRIS LANING, U. S. NAVY

Although the foundation and structure that make success in war possible are built in time of peace the architects and builders are soon forgotten and usually only the tenants who occupy the structure when the successes come are remembered in history. We may therefore feel grateful to Rear Admiral Albert Gleaves, U. S. Navy, (Retired), for giving us, in his *Life and Letters of Rear Admiral S. B. Luce, U. S. Navy*, an historical record of one who probably did more than any other officer to bring the U. S. Navy, and with it our country, to its present high position of influence in the world's affairs. Not only does the book record facts of historical importance in our development as an outstanding naval power, with which facts all men in public life should be familiar, but it records them in a way to inspire the reader either to follow the example set by Luce or at least not to stand in the way of those that do.

Admiral Gleaves' naval career started at the time when Admiral Luce was making his greatest efforts to improve the Navy. He knows the Navy as it was before, during, and after Admiral Luce exerted his influence on it. No one, therefore, could be in a better position than Admiral Gleaves to give an account of Luce's efforts, analyze their results, or point out the lessons they give us. All men in public life and naval officers in particular will find information, pleasure and profit in a careful reading of his book.

There was little of the spectacular in Admiral Luce's life for he was not one to seek notoriety or publicity. He was a student of the naval profession in each of its many ramifications, and by his work and his example sought to improve the service so it could and would do its part in bringing the United States to its proper place in the world. One would think that a man as little self seeking as Admiral Luce and whose ideas

were so sound would have not only the support of the naval service but also the support of Congress and the other branches of our government. And yet as Admiral Gleaves shows us he had the support of neither. What we might call the "Villains" of the story were always officers of high standing and repute *in the service* who could not or would not see with Luce's vision and who, in consequence, belittled and blocked Luce's every suggestion.

Fortunately Luce was persistent and in the end won recognition for all his suggestions. Reading, as Admiral Gleaves permits us to, of the ideas Luce originated, advocated, and fought for, we can only wonder what could have been wrong with other officers of that day who opposed them. Yet only a little thought will show us that even today we are not entirely different. The opposition to Luce's ideas and plans is often matched by the opposition such ideas, suggestions and plans have met in recent years. Hence in reading of Admiral Luce as Admiral Gleaves portrays him we can find a double lesson—*first,* a lesson in how we each may build for the future of our Navy and country, and *second,* a lesson as to withholding destructive criticism and opposition to really constructive suggestions.

The greater constructive works which made Admiral Luce one of our preeminent naval leaders and all of which were combatted by his brother officers were the following:

1) His attempt to have seamanship taught through the medium of a text book which he himself prepared.

2.) The creation of a system for training the "Men" of the Navy, before sending them out for general service.

3) The establishment of "Nautical School Ships" for training officers for the Merchant Marine.

4) The development of the Naval War College for teaching officers the sound principles of strategy and tactics and training them generally in the art of war.

5) The establishment of post graduate courses in Naval Architecture and Engineering.

6) The reorganization of the Navy Department from the old "Bureau system" of *civil* administration into the present organization drawn up for *war operations.*

The story of Luce's efforts to introduce the above present day *necessities* is of deep interest. A less persistant or less forceful man would have given up the task. But not so Luce and he lived to see the day when all that he advocated had become an inherent part of our naval system.

What Luce went through before his ideas became adopted is cleverly shown by Admiral Gleaves. The opposition to his plans for the betterment of the Navy was such as to cause him to be opposed in almost everything he did. Although his tact and good judgment in handling the "Canadian Fisheries" question in 1887, when he was Commander in Chief of the Atlantic fleet, probably did more than anything else to prevent trouble with Great Britain at the time, nevertheless, he was made a political catspaw and dis-

credited for his work. Wherever he turned his hand, though his work was well done, he appears to have been rebuffed. Not until he was retired were his services properly appreciated and it was only in the years after his retirement that his sound ideas and opinions were appreciated and he came to his proper place in the hearts of his countrymen. It is possible, however, that he never came into his own with the part of the Navy that opposed him.

In addition to the interesting story of accomplishment in the face of the machinations of those opposed to him the book is replete with letters to and from Admiral Luce touching upon the more important naval and international questions of his time. We can only view with awe the opinions he expressed in connection with those matters, opinions that appear sound even in the light of subsequent happenings. The letters of his later life are no less interesting and profitable to read than the story of his work while on the active list of the Navy.

Taken all in all Admiral Gleaves has filled, in a most interesting way, a very large gap in the history of the United States Navy. Told in the simple language of the sea the book, like its subject, is unostentatious, quiet, effective. It is worth any man's while to read it and the naval officer who does not read it will certainly be the loser. He will never know his Navy until he has studied and understands the part Rear Admiral S. B. Luce had in its making. Nor will he ever be all he can be to the Navy and his country unless he profits by the lessons the life of Rear Admiral Luce affords.

THE LIFE AND LETTERS OF WALTER H. PAGE. 3rd Volume. By Burton Jesse Hendrick. Doubleday, Page & Co., Garden City, N. Y. $5.00.

The first two volumes of this series, published in 1922, took the reading world by storm and are still among the most popular books in the United States. The reasons for their popularity are threefold, (1) The subject matter, the relations of Great Britain and the United States, is of interest to all intelligent citizens of both countries; (2) The charm of Page's literary style, his obvious sincerity and the eloquent and courageous way he voiced the feeling of many of his fellow citizens on the questions at issue, pleased thousands of readers; (3) Hendrick, his literary executor, wisely permitted Pages's letters to reveal the man's character and understanding and unfold those stirring events which sorely tried British-American relations during our neutrality.

Page's letters to President Wilson form the basis of the 3rd volume, also edited by Hendrick, and cover the same period of time as the first two volumes. These letters are necessary to complete the picture of events Page laid before the President.

The first of these letters are from Page, the publisher, to Wilson, the writer, and indicate the high value Page placed on Wilson's writings,

their agreement on all questions of government and their liberal ideas. It was during these years that Page first thought of Wilson as a presidential possibility. Page was one of that small group of original Wilson men, who helped secure Wilson's nomination at Baltimore, and took an active part in the campaign which elected him president. Page was first slated for Secretary of Agriculture, but the slate makers finally omitted him from the cabinet and early in March he was offered the London embassy, where he arrived in May, 1913.

The questions agitating the British public when Page arrived in London were mainly domestic, including Lloyd Georges' income taxes, the suffragettes and home rule for Ireland. Asquith headed the government which was maintained in power by a coalition of Liberals and Irish. Sir Edward Grey was at the Foreign Office.

The outstanding question between Great Britain and the United States was the Panama Canal tolls. This was regarded as vital in Britain for if American merchant vessels were not subject to tolls they could underbid British vessels which transited the canal. Convinced of the justice of British claims, Wilson after much opposition, secured the repeal of the law imposing tolls on foreign vessels and was acclaimed in Britain for his high ideals.

Early in 1914 the situation in Mexico went from bad to worse. Wilson, determined to change Mexico's revolutionary habits, would not intervene; the Monroe Doctrine denied the British that privilege. On account of Wilson's action in the Panama Canal tolls, the British government refrained from taking direct action to protect her own nationals in Mexico, or insisting on the United States doing so, although public opinion in England demanded that Benton, a British citizen murdered in Mexico, be avenged. Page's letters give a very interesting account of the growing tension between the two countries on account of Mexico, and his spirited and successful defense of our contention. The World War forced the question of Mexico into the background until the clumsy Zimmerman, grasping at a straw, endeavored to set Carranza on the United States, but before the question was solved, the Cowdray interests had agreed to give up their oil concessions in Central and South America.

Page briefly alludes to House's trip to Berlin, Paris, and London in the spring of 1914, in the effort to reduce armaments. Berlin was in the hands of the War Lords. Paris, with a new government weekly, was absorbed by Madame Caillaux. London had such a deep-seated mistrust of Berlin that no good came of the attempt except to convince House and Page that Germany was completely dominated by its military chiefs.

After his arrival in London, Page busied himself addressing various British audiences to give them the point of view of the United States on current questions. His knowledge of British history and literature, his acquaintance with the historical background of their ceremonies and customs, and his personal charm made his speeches very popular in England, but for those very reasons subjected him to criticism as pro-British at home.

Page, sure of his own Americanism and convinced that his main task was to cultivate a better understanding between the two countries, ignored these attacks, and made no effort to conceal his admiration for the stately homes, the picture galleries and the well ordered lives of the British aristocracy. He knew and admired the virtues of the British people and their many contributions to civilization, and while aware that many defects existed in the British system of government, he considered them removable, and he became more and more convinced that the future happiness of the world depended upon a sympathetic understanding between the two countries, and to that consummation he dedicated himself. He even persuaded himself that Great Britain was willing to be a junior member of the firm United States and Great Britain, provided she was treated courteously.

Among Page's earliest friends was Sir Edward Grey, British foreign minister, who convinced of the value of the friendship of the United States to Great Britain, was prepared to go to great lengths to cultivate the good opinion of the United States. These two men soon became close friends and apparently put aside all diplomatic reserve in their personal and official relations.

By August 1914, Page was thoroughly established in England and had unconsciously absorbed the English point of view on many questions, yet his letters at the outbreak of war indicate that he could still view the coming struggle with a certain degree of detachment. The invasion of Belgium, the ruthlessness of Germany and his sympathy for his many British friends soon inclined his sentiments to the Allied cause; the inevitable hostility between Kaiserism and American institutions was as quickly grasped by his keen mind, and by September he was completely committed to the Allied cause.

Page had difficulty in explaining to himself the presence of autocratic Russia on the side of the Allies, and his letters afford evidence that he never satisfactorily solved his problem. Had Page known more of Europe, he would have realized that foreign alliances result from necessity not desire, and he could have learned from Grey the price England had already paid for her muscovite ally.

Page knew much of Chaucer, Shakespeare, Hampden, Cobden, and Bright; he understood the England which faces west, which gave parliaments to the world, which prides itself on Canada, Australia and even the United States, the England represented by the *Manchester Guardian*. Apparently Page was not so fully acquainted with the England of Disraeli and Curzon, which faces east, with its viceroys and governors general ruling, and ruling well, by edict, which regards India as the Empire's most precious jewel and whose imperial voice is *The Morning Post*. Grey knew both Englands, his sympathies perhaps lay with the westerners, but the necessities of foreign policy aligned Great Britain with Russia. He, better than any other person in England, could have removed Page's perplexities on this subject.

Between the United States, the leading neutral, and Great Britain, the dominant sea power, differences of opinion on questions of blockade and

contraband of war were inevitable. The theory and practice in the past of neither nation were consistent. As neutrals and ocean carriers, both have always strenuously supported the rights of its citizens and ships on the high seas; when belligerents, they have always applied their belligerent rights with the utmost severity. England has always been in a dilemma on this subject, because as a neutral her prosperity depends on the uninterrupted activity of her merchant marine, as a belligerent her greatest weapon is her navy and its ability to drive her enemies' commerce off the sea. Her commercial interests have usually been in favor of restricting the rights of belligerents, her Admiralty except when muzzled by the Cabinet has been in favor of extending the rights of belligerents.

In 1908, under the influence of commerce, Grey summoned to the London Conference to settle the law of the sea, the ten leading maritime nations, Great Britain, Germany, United States, Japan, France, Russia, Austria, Italy, Holland, and Spain. This law, under the provisions of the Hague Conference of 1907, would be administered by an International Prize Court. This confernce, under the lead of Continental powers like France and Russia, and only slightly opposed by naval powers like Great Britain, Germany, Japan, and the United States, restricted the rights of belligerents on the sea and practically nullified the value of sea power. The United States ratified this conference, Germany did with certain reservations, the House of Commons under Grey's leadership ratified, but the House of Lords refused to ratify and saved Great Britain's naval power.

For some reason, not yet apparent, the American State Department was determined that Great Britain should adhere to the London Conference. Germany, for obvious reasons, desired that England should abide by the conference, for it would have enabled Germany to trade with the world via neutral countries and through neutral steamers, even British steamers. Grey realized that the Allies were dependent on the United States for supplies, but he also knew that they could not hurt Germany if she adhered to the conference. Page, under orders from the State Department, pressed three times for British adherence to the conference; when directed the fourth time to renew the request, he did so, but refused to say, as also directed, that it was his "personal suggestion and not one for which my government is responsible." Page commented very frankly on the memorandum accompanying the fourth request, and his comments bore fruit, for the question was never raised again.

The British government, which was so embarrassed by these requests to adhere to the London Conference, had only itself to blame. The instructions of this very government to its delegates to the London Conference contain the following: "The government recognizes to the full the desirability of freeing neutral commerce . . . . from interference by belligerent powers, and they are ready and willing for their part . . . . to abandon the principles of contraband of war altogether, thus allowing over-sea trade in neutral vessels between belligerents on the one hand and neutrals on the other, to continue during war without any restrictions, subject only to its exclusion by blockade from an enemy's port."

The government would like "to see the right of search restricted in every practicable way."

"If arrangement can be made for the abolition of contraband, His Majesty's Government would be willing . . . . that it should also include "analogues of contraband"; viz, the carriage of belligerent despatches and of persons in the naval and military services of the belligerents." The British government had no trouble in getting the weaker naval powers to agree to restrict belligerent rights on the sea, France and Russia had always been in favor of so doing. Lord Loreburn, who defended the government attitude, admitted that "continental powers would be able to trade freely . . . . even when at war, untouched by the powerful fleets of Great Britain" yet urged the adoption, not on sentimental or humane grounds, but because he thought "the interest of Great Britain will gain much" from the proposed changes. Grey subscribed to these views and secured the approval of the House of Commons.

When Page was urging England's adherence to the London Conference, he probably did not realize the discomfiture Grey must have felt in having to disavow a conference he had fathered. Grey, in his *Twenty Five Years*, indicates that after the war began he was not entirely pleased with his creation, but comforted himself with the reflection that if the conference had been ratified, the stress of war would have forced its abandonment.

Lest the United States feel superior in this matter, it must be added that while there were a few minor advantages to Great Britain in the London Conference, there were none to the United States; and while one wise and patriotic Britisher, T. Gibson Bowles, realizing the national peril, succeeded in preventing its adoption, no voice was raised in this country, not even by naval officers, against our adhering to an agreement that would have completely emasculated our naval power during war, and our own War College placed its approval on this indefensible document.

Page was not troubled any more by requests from Washington about the London Conference, but scarcely a day went by without some protest from the United States concerning British interference with American commerce. Page regarded these as minor irritants, and softened them whenever possible. His most significant action was when he advised Grey to let the French Navy seize the *Dacia*. It is difficult to justify Page's conduct in this matter. He realized that he was out of sympathy with the President, he believed perhaps correctly that his views more nearly represented his countrymen than the President's hence his action. On Page's behalf, it can be urged that the circumstances were extraordinary, that his resignation might have precipitated a crisis between the two countries and that certainly had he insisted on some of our protests, the British government would have no choice but to except our hostility for she could not let us freely trade with Germany and win the war.

With all Page's wisdom, his ignorance of military affairs led him into many curious errors: as Page has remarked, the inability of naval officers to comprehend large affairs of government, it is perhaps fair to note the

limitations of a civilian mind and that mind an unusually keen and informed one. In October, 1915, Page informed the President of a wonderful intelligence stunt of the British which made the Germans withdraw considerable numbers of troops from France to Antwerp. In the same letter he informed Mr. Wilson that the English had destroyed so many German submarines that the Germans agreed not to attack merchant ships without warning to avoid confessing the failure of the submarine campaign. Page accepted without question newspapers stories that England would have a million and a half men in France in the Spring of 1915, and expected Kitchener to capture Berlin with this phantom army. He also made some very curious estimates of the result of the war. He thought England would be more powerful but under definite obligations to Russia and Japan. In other moods, Page saw nothing but a hopeless deadlock and believed that the United States alone could break this deadlock.

At the beginning of the war, Page had a plan to end the war. In a letter to the President on October 6, 1914, Page suggested that the President say to England:

> Now you wish to end militarism? Very well, we will recall our neutrality; we will sell you guns and ammunition; we will sell nothing to Germany; if necessary we will let our citizens volunteer in your army; you may have our navy if you need it: Now what abridgement or armament will you make after this war if we thus help you end it?

Page himself was not at all sure of the answer the Allies would have made to this proposal and as the proposal itself was never made, it is only important as one of Page's reflections and of its similarity with the "House Memorandum" early in 1916 which embodied this same idea only the President was then willing to make the same offer to the Allies and to the Germans. Both these attempts were failures because the European belligerents were unwilling to have a "peace without victory."

Early in the war there was an unexpressed feeling in England that the Russians might suddenly quit. This feeling was very unfair to an ally who sacrificed the flower of its army to relieve the pressure on France, but it illustrates the great difficulty of all alliances, and the impossibility of expecting real cooperation between great nations when they are allied. Later on in the war, Page remarked that if the Allies did not hang together better, they would hang separately, paraphrasing a remark of a famous American.

After the sinking of the *Lusitania*, the gulf between Page and the President widened. He still endeavored to convince the President that he should intervene on the side of the Allies. The President scarcely read the letters that Page wrote, and is reported to have remarked that Page was more British than the British themselves. The war shattered the friendship existing between these two men, and although subsequent to our entry into the war, there was a reconciliation, it is doubtful if the old intimacy was ever resumed. Both Page and Wilson sacrificed their lives for what they considered right, and were equally victims of the war. In his letters, Page gives an illuminating and apt comparison of Jefferson and Wilson, with which many students of history will agree.

After Bernstoff had been dismissed and the United States was on the verge of war but still unwilling to take the final step, the Zimmermann dispatches were intercepted and created such an indignation in the country that it was impossible to prevent our entry into the war. Page tells how these dispatches were intercepted and decoded, and of their careful verification before publication. The pro-German press in the United States, with their usual alacrity, had already proved the falsity of these dispatches before Zimmermann left them in the lurch by acknowledging their authenticity.

The British are a proud, reserved people, but they know and appreciate real friends. The British Government early in the war realized that Page understood and sympathized with their aims. In time, the British people came to realize that Page had sympathetically explained their side of the war to the United States and Britain has shown the world that she is not too proud to publicly acknowledge her indebtedness to a friend. Probably no individual has been so signally honored by a foreign nation as Page has been by Great Britain. A tablet in Westminster Abbey in memory of Walter Hines Page bears this inscription:

"A Friend of Britain In Her Sorest Need."

W. D. P.

INTIMATE PAPERS OF COLONEL HOUSE. Edited by Charles Seymour, Professor of History, Yale University. Houghton-Mifflin Company. 2 vols. $10. (See Secretary's Notes, this issue).

Reviewed last month but price omitted.

NAVAL HISTORICAL FOUNDATION

The Board of Control of the United States Naval Institute has given careful and deliberate consideration to the merits of the above referred to organization, which is now being incorporated (see page 108, January, 1926, Proceedings); and, having in mind the mission of the Institute, the Members of the Board have unanimously decided that it would be mutually advantageous to both organizations for the Institute to make an initial contribution to the Foundation's Endowment Fund.

A member of the Board of Control will represent the Naval Institute on the Board of Trustees when the Foundation has been incorporated.

In accordance with the above decision, the Board of Control has favorably acted upon the following resolution:

> "Resolved that the Board of Control appropriates a sum of One Thousand Dollars ($1,000) for the further advancement of Professional, literary, and scientific knowledge in the Navy; this sum to be paid to the Naval Historical Foundation, if and when established to be a corporation, for the procurement of selected manuscript and other sources of naval history."

SECRETARY'S NOTES

Circulation

The circulation of the PROCEEDINGS has increased since January, 1926, 252 copies.

Important Current Naval Topics

The three articles published in the March issue by contributors Bywater, Anderson, and Pratt, covered subjects which are of particular and vital interest not only to the country and to the Navy but to each individual officer of the Navy and Marine Corps. The range of subjects covered included the future of the battleship, new construction, the limitation of naval armament, and the air policy of the United States as effected by international law. These articles are of deep interest to the service at large, in view of the coming Geneva Disarmament Conference, where a further attempt will be made to limit armament by agreement. In this issue of the PROCEEDINGS will be found two important articles, viz., "Summary of German Submarine Operations," by Captain A. Gayer, German Navy, translated for the Institute, by special permission of the author, by Commander W. P. Beehler, U. S. N. (Retired), and "The Cruiser," by Lieutenant (j.g.) William Webster, (CC) U. S. N. The former article, in addition to the usual interest which would be attached to an article of this kind, is of special interest at the present in view of the agitation for the abolition of the submarine, which question will undoubtedly come up at Geneva. The latter article is also important at this time in view of the question raised abroad of doing away with the capital ship, together with the ever increasing interest displayed as to the type of cruiser which will be evolved as a result of the Washington Conference, the latter having decreed certain limitations as to the displacement and caliber of gun permitted in the design of future cruisers.

Special Article on German Submarines

In the May issue of the PROCEEDINGS there will appear an article entitled "The Value of the Submarine in Naval Warfare, based on the German experience

in war," by Rear Admiral Spindler, German Navy. This article has not been published elsewhere, and was written especially for the PROCEEDINGS, Commander W. P. Beehler, U. S. N. (Retired), having translated the article for the author. It is of timely interest for obvious reasons.

The May issue will also contain an article entitled "Diesel Engined Warships," by M. F. Gunning, Naval Constructor in the Royal Dutch Navy, who submitted the article in the Prize Essay Contest for 1926. His paper is timely in view of the possible use of Diesel engines in new ship construction, to which reference was made by Hector C. Bywater in his Prize Essay in the March PROCEEDINGS.

Annual Report and Financial Statement 1925

Attention is invited to the annual report and to the Financial Statement of the Secretary-Treasurer, appearing elsewhere in this issue.

America and the Capital Ship

In the Secretary's Notes in the December issue appeared a paragraph headed "Is the Capital Ship Doomed?" In the March issue, page 559, Professional Notes section, appears a comment on the above mentioned paragraph, by Sir Herbert Russell, which appeared in the *Navy and Military Record* of 30 December, 1925.

The House Papers

In the PROCEEDINGS for last month, Book Review section, there appeared a reference to "The Intimate Papers of Colonel House," edited and arranged as a narrative by Charles Seymour, Professor of History, Yale University. Attention was invited to the Prefatory Note by Colonel House, wherein certain statements were made and, among others, that ". . . . given a large and efficient Army and Navy, the United States would have become the arbiter of peace, and probably without the loss of a single life. . . . ." It is not usual to mention books in these pages, but the subject matter revealed in the House Papers, published in two volumes by Houghton-Mifflin Company, is of such interest and importance to every naval officer, bearing as they do upon the

preparation of America both prior to and upon entry into the World War, upon various questions of international law such as blockade, the seizure of neutral ships, the arming of merchantmen, Germany's use of the submarine, and the military employment of dirigibles and planes, together with questions of policy, that they fully warrant attention being invited to them. They disclose a wealth of information from one admittedly close to and regarded by nearly everyone as the most intimate adviser of the late President Wilson.

The Dardanelles Expedition Attention is invited to the page facing page 814 this issue.

Corrections In the March issue, page 498, the first line should be corrected to read ". . . . officers are expected to be operative engineers in the lines of ship . . . . "; on the same page, fourth paragraph from the bottom, the last sentence should be corrected to read "Therefore all operatives need *not* also be gifted planners." The author of this discussion, Lieutenant Commander, F. S. Craven, U. S. N., writes to the editor: "May I also have corrected a mistake of my own? I have several times used the word *"planning" (or "planners")* where I should have used the words *"conceptive planning" (or "conceptive planners")*. It will be recognized that there is an important distinction here, since all executive work involves some sort of planning as a usual thing." The latter corrections refer to the following lines on page 498: counting from the top of the page, lines 11 (in two places), 15, 27, 32, and 35.

Membership: New members joining since last report:

Roskruge, G. J., Mr.
Schubert, R. H., Lieut., U.S.M.C.
Ceres, A. F., Jr., Mr.
Hough, E. B., Mr.
Clouston, J. C., Lieut., R.N.
Story, B. Q., Mr.
Mikawa, G. Lieut. Comdr. I. J. N.
Aldridge, D. R., Mr.
DeWolfe, R. R., Midn., U.S.N.
Hasegawa, K., Captain, I.J.N.
Lin, C. S., Lieut., C.F.M.F.
Heurich, Christian, Mr.
Hall, C. J., Mr.
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Biddle, Samuel, Mr.
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Hamilton, C. H., Mr.
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Verrill, H. W., Mr.
Stubbs, Daniel, Ensign, U.S.N.
Broun, W. F., Lieut., U. S. N.
Durand, W. F., Prof.
Henderson, C. F., Mr.
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Prebble, Susie Z., Miss
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Townsend, Lawrence, Mr.
Geer, L. E., Mr.
Galvin, W. M., Mr.
Horton, G. T., Mr.
Goodrich, A. W., Mr.
Broome, Thornhill, Mr.
Block, E. J., Mr.
Anderson, J. F., Mr.
Willing, M. S., Mr.
Nerney, T. A., Captain N.M.C. (Ret).
Rosseter, J. H., Mr.
Steele, E. H., Mr.
Swift, A. B., Mr.
Powell, C. G., Mr.
Richter, R. M., Mr.
Menander, J. E., Mr.
Carpenter, C. A., Mr.
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Platt, H. R., Mr.
Menge, A. J., Mr.
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Colvin, J. B., Mr.
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Worthington, J. M., Ensign, U.S.N.
Betsch, W. G. L., Mr.
Harvey, H. P. B., Mr.
Cahn, M. W., Mrs.
Edwards, C. B., Mr.
Weston, Edward, Mr.
Ditson, J. E., Mr.
Tracy, H. D., Mr.
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Pike, M. W., Miss
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Dudley, T. H., Mr.
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Baker, E. H., Mr.
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Furber, E. L., Mr.
Pun, J. M., Mr.
Meyer, A. W., Mr.
Blackstone, H., Mr.
Kurimoto, T., Mr.
Dahlgren, Ulric, Mr.
Moffett, W. A., Rear Admiral, U.S.N.
French, T. E., Mr.
Lane, A. C., Mr.
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Cheney, L. R., Mr.
Cousins, T. F., Mr.
Fullerton, Loring, Mr.
Howe, Lucian, Mr.
Leonard, R. W., Mr.
Spiegel, Walter, Mr.
Loomis, Guy, Mr.
Jeffers, W. W., Mr.
Hemingway, W. L., Mr.
Eckhart, Edmund, Mr.
Abrams, L. A., Mr.
Walsh, E. J., Mr.
Kluge, E. H., Mr.
Fox, C. E., Mrs.
Shipman, E. W., Dr.
Kibbey, B. J., Miss
Packard, J. W., Mr.
Ludlum, C. A., Mr.

MINUTES OF ANNUAL MEETING, 1925

In accordance with Article VIII, Section 3, of the Constitution and By-laws the annual meeting of the Naval Institute was held at the Officers' Club, U. S. Naval Academy, at 8:30 P.M., February 18, 1926.

Brigadier General George Richards, U. S. M. C., senior director, presided.

The reading of the minutes of the last annual meeting was dispensed with, having already been published in the PROCEEDINGS.

The Secretary submitted the following report, including the audited financial statement for the calendar year 1925:

THE PRESIDING OFFICER AND MEMBERS OF THE INSTITUTE:

This is the first annual meeting held in accordance with the new Constitution and By-Laws, the date having been changed from the second Friday in October to the third Thursday in February. This change was made, you will recall, in order to permit the annual financial statement, as of December 31, to be submitted at the annual meeting, which was impossible in the past when the meeting took place in October.

CONSTITUTION AND BY-LAWS

The changes in the Constitution and By-laws adopted in October 1924, have now been in effect for sixteen months. It is believed the results have justified the changes, and the Secretary-Treasurer has no suggestions or recommendations to make in regard to any further changes in the Constitution and By-Laws.

MEMBERSHIP

The present membership, as of February 18, 1926, consists of 2,564 Regular Members, 1066 Associate Members, 139 Life Members, and 4 Honorary Members, making a total of 3,773.

Subscriptions are as follows: Domestic, 164; foreign, 414, a total of 578.

In addition to the above, the Institute exchanges publications as follows: Domestic, 25; foreign, 14; and 128 copies to advertisers.

The total circulation is thus at the present time 4,518.

The net changes from October 10, 1924, to February 15, 1926, a period of sixteen months, are as follows:

Deaths	49
Resignations	382
Members dropped	393
Total	824
New members	222
Net decrease in membership	602

The net loss in members during the year 1922 was 653; in the year 1923, 244; and in the year 1924, 233.

The Institute, as has been noted in previous reports of Secretary-Treasurers, has been suffering a loss in membership since the cessation of the activities of the World War. Due to the drastic action of the Board of Control two years ago and the changes in the Constitution and By-Laws, which resulted in the suspension and dropping of members owing back dues, together with other measures adopted, it is believed the membership today is down to a bedrock stabilized level, from which level the membership should again rise. Attention is invited further to the fact that the Dues Receivable as of 31 December, 1925, were only $823.36, for which a reserve of $1,500 has been set up. As against this, the Dues Receivable in arrears on October 10, 1924, amounted to $3,320.51. Not for many years has the financial history of the Naval Institute disclosed dues in arrears to be so low.

Last year's annual report of the Secretary-Treasurer showed that in the fifty-year period of the Institute there had been a loss of over $14,000 resulting from non-payment of dues. Under the present By-Laws such losses cannot occur.

Efforts are still being made to increase the membership. At the present time, the Board of Control is offering to members of the Navy League the privilege of becoming Associate Members of the Institute, if the privilege is taken advantage of within thirty days after receipt of the offer.

An analysis of the membership of the commissioned officers of the regular services discloses that of the line of the Navy, approximately 6 out of every 10 flag officers retain their membership when they retire; that 8 out of every 10 flag officers on the active list are members; and the figures for the other grades down to and including lieutenant of the active list of the line are as follows: Captains, 7 out of 10; Commanders 6 out of 10; Lieutenant Commanders, 5 out of 10; Lieutenants, 5 out of 10. A further study of the situation shows that the field for increasing the Institute's membership lies in the grades of lieutenant j. g., and ensign, together with obtaining additional members from the staff corps of the Navy, Marine Corps, and from civilians, the latter as Associate Members. The Board of Control has also had under consideration the question of the advisability of seeking to obtain new members in addition to those belonging to the Navy League, from a class of citizens represented by, say the National Geographic Society. In this connection, the financial question must be carefully considered as to whether or not the Institute could afford to send the PROCEEDINGS to a large associate membership which paid only $3.00 per year dues; and at this time the Secretary-Treasurer is not in a position to definitely recommend such a step, as a further study of the costs involved must be made.

PROCEEDINGS

The PROCEEDINGS are still printed in Menasha, Wisconsin, and the Board of Control has deemed it wise for business reasons to continue the procedure adopted a few years ago, which materially reduced costs. Since the last annual meeting, the following changes have taken place in the makeup of the PROCEEDINGS:

(a) At the top of all left hand pages appear the words "U. S. Naval Institute Proceedings" and the month; at the top of all right hand pages appear the year and the title of the article. This change was suggested by Lieutenant Neil B. Musser, (CC) U.S.N., and adopted by the Board of Control for the reason that these identification marks offer a member a convenient method of filing certain pages of the Proceedings. This caused no additional expense to the Institute.

(b) Beginning with the December, 1925, number a new quality of paper was used, being somewhat whiter in color but of the same grade and cost. It is believed the appearance of the magazine is thereby improved.

(c) Beginning with the January, 1926, number a "plate finish" paper was used for the cover. The paper is the same in quality and price as

that previously used, but the finer finish is very advantageous to the Institute in that it will reproduce cuts and illustrations of our advertisers to much better advantage; and there has been a resultant financial gain to the PROCEEDINGS in that certain advertisers who had threatened to discontinue their advertising remained with us, and prospective advertisers who had refrained, subsequently gave us advertising.

A reference was made in the last annual report to the new system adopted whereby all advertising for the PROCEEDINGS is handled by a professional firm. This innovation, adopted by the Board of Control upon the recommendation of my predecessor, has been of material advantage to the Naval Institute, as will be seen from the following figures:

For the year ended 31 December, 1923, the PROCEEDINGS received from advertising the sum of $2,760.93; for the year ended 31 December, 1924, $3,032.65; and for the past year, $7,641.54. It is confidently believed that the current year will see the income from this source materially increased. The increase of revenue from this source during the past year was largely put into the PROCEEDINGS, to publish a greater number and variety of articles, and, it is hoped, resulted in commensurate increased value to the members. The increase in the number of pages printed during the year just closed was approximately equivalent to thirteen and one half monthly issues, as compared with the preceding year.

The financial statement will disclose that, not counting overhead, there was a loss on the PROCEEDINGS for the past year of $1,582.87, as compared with a loss the previous year of $945.30. The reasons for same are mostly explained by the greater amount of material published. In closing this subject, it may be stated that, while it is desirable that the PROCEEDINGS should pay for itself, the policy has been and will be, as in the past, to make the PROCEEDINGS as valuable as possible, provided the loss does not become prohibitive. It is believed that the additional loss of some seven hundred dollars incurred in the past year over the preceding year does not fall within the above category. With additional advertising received during the coming year it is believed that the PROCEEDINGS will be published without loss and without impairing the magazine in any way.

INSTITUTE PUBLICATIONS AND PURCHASED BOOKS

The total sales of Institute publications has amounted to $50,761.44, and of purchased books obtained from outside publishers, $4,656.06. The total business of the Institute for the year, including the PROCEEDINGS, has thus been $76,906.41, and the total operating cost, including overhead, has been $75890.95, making the net profit for the year $1,015.46. The Institute has therefore done approximately $77,000 worth of business, with a net profit of a little over a thousand dollars, the actual percentage of profit on sales being 1.32%. The gross profit, as will be seen when the financial statement is presented, is some $8,000 in excess of this amount, due to interest from bank deposits and bonds. The gross profit for the year was reduced approximately one-half by charging off certain old and inactive books from the inventory which probably never will be sold, as will be explained later.

CHANGE IN ASSETS

The net worth of the Institute, as of December 31, 1925, is $184,507.74, an increase of $4,113.03. During the year the Board of Control authorized the charging off of $14,446.67 from the inventory on obsolete Institute publications, which resulted in reducing the surplus by $5,035.82, this being in reality an additional depreciation.

OVERHEAD

Overhead is a considerable item, and every effort has been made and is being made to reduce it. The overhead for the year ended December 31, 1925,

was practically the same as for the preceding year, after allowing for the increase of salaries to the civilian staff of the Institute granted by the Board in December, 1924.

BOOKS PUBLISHED AND TO BE PUBLISHED

New Books

Some Recent Essays and Poems, a reprint of some recent poems and essays taken from various sources with permission of the authors and publishers for use by the third class;

Naval Architecture and Warship Construction, a new book published under the supervision of the Department of Engineering and Aeronautics to take the place of Robinson's *Naval Construction;*

Naval Aviation, a new book published under the supervision of the Department of Seamanship and Flight Tactics, for the use of the midshipmen in that department;

The Principles of the Basic Mechanisms, prepared under the supervision of the Department of Engineering and Aeronautics, to replace *Elements of Mechanism;*

Ce'o-Navigation, prepared by Commander Dutton for use in the Department of Navigation and to be used in conjunction with *Navigation, 1922*, as regards the method of reckoning time from midnight to midnight instead of noon to noon;

Radio Manual, prepared under the supervision of the Department of Electrical Engineering and Physics because no suitable book on the subject of radio could be found in the open market;

Engineering Mathematics, prepared under the supervision of the Department of Mathematics and designed to connect up that department with the mathematical work in the other deparments at the Academy;

Laboratory Manuals, prepared under the supervision of the Department of Electrical Engineering and Physics in four subjects, as follows: Alternating Current, Direct Current, Physics, and Radio;

Internal Combustion Engines. This book was printed in 1920 by Ginn and Co., of Boston. As they were not in a position to revise it to the satisfaction of the Department of Engineering and Aeronautics, they were asked to sell the publication rights and plates to the Institute. This they agreed to do, and the book was then thoroughly revised and brought out for the first time by the Institute.

Reprints and Revisions Published

Constitutional Law. This book was revised and reprinted at the request of the Military Academy for use there as a textbook in the subject;

Naval Electricians' Textbook, Volume I. Advantage was taken of the exhaustion of the 1922 edition to incorporate some changes and to make numerous corrections in the text;

International Law. A slightly revised edition was printed, the principal addition being a short article on angary;

Naval Leadership was reprinted with a few minor corrections;

Notes on Naval Communications was reprinted with very slight changes;

Naval Ordnance. A thorough revision under the supervision of the Department of Ordnance and Gunnery was published last summer;

Physiology was reprinted without change;

Manual of Radio Telegraphy and Telephony. This edition is a thorough revision and greatly enlarged edition of the 1919 book. It now contains some 900 pages;

Spanish Reader was revised and brought up to date in the present reprint;

Naval Aviation was reprinted with slight changes.

Books Now in Press

Elementary Mechanics. This book is scheduled for delivery in the next few days and is a complete revision of the 1922 edition;

Engineering Materials and Processes, a new book scheduled for delivery about 15 March. This book was prepared under the supervision of the Department of Engineering and Aeronautics. It will replace Danforth's *Mechanical Processes* as a textbook at the Naval Academy.

New Books in Preparation

Navigation, a book being prepared by Commander Dutton which will replace *Navigation, 1922* and *Celo-Navigation* in the Navigation Department;

Shop Practices, is in preparation for use with its companion volume *Engineering Materials and Processes,* to replace Danforth's *Mechanical Processes.*

Books to Be Revised

Engineering Mathematics. This book was gotten out with a new set of page numbers and a new set of figure numbers for each chapter, so that any chapter could be revised in length or omitted entirely without altering the pagination of the remainder of the book, thus effecting a considerable saving in the case of revisions;

Radio Manual. The remarks under *Engineering Mathematics* are applicable here also;

Reciprocating Engines and Auxiliary Machinery. The revision of this book is now in process under the supervision of the Department of Engineering and Aeronautics;

Groundwork of Practical Naval Gunnery. A thorough revision is now being worked out by the Department of Ordnance and Gunnery;

Range and Ballistic Tables. A slight revision and the addition of one or two new tables for the large guns are to be included by the Department of Ordnance and Gunnery;

Laboratory Manuals. The four manuals under this subject require slight annual revisions to meet the demands of the Department of Electrical Engineering and Physics.

Investment Policy

It will be remembered that the new Constitution and By-Laws made necessary a consultation with a well known investment agency *re* the investments of the Institute. During the past year, Moody's Investors Service passed upon each and every bond and gave its unqualified approval to the bonds owned by the Institute, and recommended that all be retained. During the year, upon recommendation of Moody, new bonds to the extent of $25,000 par value were purchased by the Institute. These bonds net approximately 5 per cent and were rated by Moody as of the very highest grade, viz., AAA. They were as follows:

$ 5,000 CAROLINA, CLINCHFIELD & OHIO RWY CO., 6s of 1952
10,000 NEW YORK EDISON 5s of 1944
10,000 CONSOLIDATED GAS COMPANY OF BALTIMORE 5s of 1939

General

Referring to the immediate past and future, it is believed the Naval Institute approaches stabilized conditions. It must be recalled that the Institute suffered more or less from the war conditions, as did all business organizations; and a period of recovery has been necessary. The membership list today as previously noted, is believed to have reached normal, so far as loss is concerned, and comparatively few members are in arrears for dues. As regards inventory, this has been reduced to the very minimum, and the value of the inventory of Institute publications is about $21,000.

The inventory now consists of active books for which a sale in the next three years is in sight.

There is something to consider for the future as regards sale of the Institute's books to the Midshipmen's Store. For several years in the past, the number of appointments of midshipmen to the Academy have been greater than they are now, and the number of midshipmen buying professional textbooks of the Institute through the store has been in excess of 2,000 being as high three or four years ago as 2,500. Today the regiment of midshipmen is in the neighborhood of 1,700; and it is a fair estimate to make that for the next several years the gross receipts from these sales to midshipmen through the store will be approximately three-fifths of what they have been in the past. The Board of Control and the Secretary-Treasurer, and succeeding administrations must bear the above conditions in mind in guiding the financial policy of the Institute. In the book publishing business there is a considerable difference in the retail price per copy of a book which has an edition of 2,000 and one which has an edition of 1,200.

Due to the inauguration of my predecessors and previous Boards of Control of a policy of shopping around among a greater number of printing establishments, the Institute has been enabled to reduce its costs of printing very materially; and despite the great increase in the price of materials and labor in the past ten years, the Institute has nevertheless been enabled to supply its publications at very little increased prices. In this connection, attention is invited again to the fact that during the preceding year the total business of the Institute was some $77,000 gross sales, upon which there was a net profit of only $1,015.46.

The Tellers, Captain W. S. Anderson, Commander S. A. Clement, and Lieutenant Commander Frank Singluff, Jr., previously appointed by the Board of Control in accordance with the Constitution, announced the result of the election, as follows:

President: Rear Admiral Hilary P. Jones, U.S.N.
Vice-President: Rear Admiral Louis M. Nulton, U.S.N.
Secretary-Treasurer: Captain H. A. Baldridge, U.S.N.
Directors: Captain W. T. Cluverius, U.S.N.
Commander Byron McCandless, U.S.N.
Brigadier General George Richards, U.S.M.C.
Captain W. G. DuBose, (CC) U.S.N.
Captain G. J. Rowcliff, U.S.N.
Captain P. B. Dungan, U.S.N.

Rear Admiral Hilary P. Jones. U. S. N., the president elect was inducted into office and assumed the chair. Commenting on his election, Admiral Jones said "I desire to say that I am deeply appreciative of this honor. I feel somewhat unworthy of holding such a position, but assure you that I will do my best to live up to the policy of my distinguished predecessors." The President requested General Richards to open for discussion the subject of the proposed trust fund.

GENERAL RICHARDS: "Mr. President: There appeared in the January issue of the PROCEEDINGS an article by Captain Dudley W. Knox, entitled "Our Vanishing History and Traditions." Prior to its publication it was submitted to a number of members of the Institute, and Admiral Strauss suggested that perhaps steps might be taken by the Board of Control of the Naval Insti-

tute towards creating a trust fund. The Board has not formally discussed the question or decided on a policy, but I believe the majority of the members of the Board are favorable to the Naval Institute's taking some initiative towards creating a foundation. Naturally, the Board feels that before taking any steps toward this matter it would like to have expressions of opinion from the members themselves. So that was invited in the January PROCEEDINGS. We have not yet received any proposition from the members, but would like to suggest the hope that some members here might offer something which the Secretary could submit to the Board as a sort of tentative plan."

Admiral Jones stated that Captain Knox had given him a list of documents, etc., which were in private hands and which might be purchased. The list was distributed among the members present at the meeting.

Commander A. M. R. Allen suggested that the matter be put in concrete form and submitted to the members of the Institute for a vote.

Commenting on this, General Richards said "Mr. President, I believe that would be the safest course. Captain Knox is very anxious to secure this while the documents, etc., are for sale and it would take some time to submit it to the entire membership, but I believe it would be the best plan."

After considerable discussion a proposition was moved, seconded, and carried that a concrete plan for assisting the trust fund be drawn up and presented to the Institute's membership for approval or disapproval.

The meeting then, at 10:25 P.M., adjourned.

ANNUAL FINANCIAL STATEMENT

UNITED STATES NAVAL INSTITUTE,
ANNAPOLIS, MARYLAND.

AUDITORS' REPORT FOR THE YEAR ENDED DECEMBER 31, 1925

To the Officers and Members,
of the United States Naval Institute,
Annapolis, Maryland.

Gentlemen:

We have audited the books of the UNITED STATES NAVAL INSTITUTE, ANNAPOLIS, MARYLAND, for the year ended DECEMBER 31, 1925, and submit herewith a certificate, one page of comments and the following exhibits and schedules:

EXHIBIT A—BALANCE SHEET as of DECEMBER 31, 1925.
SCHEDULE No. 1—STATEMENT of CASH RECEIPTS and DISBURSEMENTS for the year ended DECEMBER 31, 1925. [*Not published here.*]
SCHEDULE No. 2—BONDS at COST. [*Not published here.*]
SCHEDULE No. 3—ACCOUNTS PAYABLE. [*Not published here.*]
SCHEDULE No. 4—SURPLUS. [*Not published here.*] All as of DECEMBER 31, 1925.

EXHIBIT B—STATEMENT of PROFIT and LOSS for the year ended DECEMBER 31, 1925.

EXHIBIT C—COMPARATIVE BALANCE SHEET DECEMBER 31, 1924—DECEMBER 31, 1925, [*Abbreviated*] and

EXHIBIT D—COMPARATIVE STATEMENT of PROFIT and LOSS for the two years ended DECEMBER 31, 1924—DECEMBER 31, 1925. [*Abbreviated*]

We have satisfied ourselves as to the correctness of the inventory.

The condition of the books, papers, records, etc., was such as to merit commendation.

CERTIFICATE

WE HAVE AUDITED the books of the UNITED STATES NAVAL INSTITUTE, ANNAPOLIS, MARYLAND, for the year ended DECEMBER 31, 1925, and

WE HEREBY CERTIFY that the accompanying BALANCE SHEET and STATEMENT of INCOME and EXPENSES are correct; and in our

opinion clearly set forth the true financial condition as of DECEMBER 31, 1925, and result of operations for the year ended DECEMBER 31, 1925, respectively.

BLACK and COMPANY,
CERTIFIED PUBLIC ACCOUNTANTS.
By: WILMER BLACK, C. P. A.

MEMBER
(American Society of Certified Public Accountants)
(Maryland Association of Certified Public Accountants)
Baltimore, Maryland, January 28, 1926.

COMMENTS upon the AUDIT for the year ended DECEMBER 31, 1925.

We have examined every Balance Sheet Account as presented by the attached Exhibit A, and have satisfied ourselves as to the existence of these various assets and liabilities.

As a matter of good judgment and sound business practice, obsolete Institute publications to the extent of $14,446.67 were charged off during the year just closed, thereby reducing inventory of January 1, 1925, from $40,621.36 to $26,174.69.

We participated in the taking of the inventory, and satisfied ourselves to the correctness both as to quantity and amount.

All accounts doubtful of collection have been charged off, while existing reserves are ample. As a result of these policies the books of the Institute reflect quite a healthy condition.

EXHIBIT A

Balance Sheet			**December 31, 1925**
ASSETS			
CASH in Bank			$ 35,076.46
ACCOUNTS RECEIVABLE			
Dues in arrears		$ 823.36	
From Advertisers		321.14	
From Book Sales	$1,153.29		
Less: Reserve	107.39	1,045.90	
Interest Accrued		2,079.84	
Total Receivables			4,270.24
OTHER ASSETS			
Bonds at Cost			141,831.34
Inventories			
Institute Publications		$19,141.97	
Purchased Books		1,636.97	
Office Supplies		820.13	21.599.07
FURNITURE and FIXTURES			1,878.69
PREPAYMENTS			
Royalty		$ 120.57	
Expense		174.34	294.91

LIABILITIES

ACCOUNTS PAYABLE		
Various Dealers	$ 2,389.03	
Accrued Royalty	569.60	
Accrued Salaries	35.00	$ 2,993.63
DEFERRED CREDITS		
Contingent Profits		8,200.71
PREPAYMENTS		
Dues of Members	$ 6,293.38	
Subscriptions to PROCEEDINGS	1,003.94	
Sundries	451.26	7,748.58
RESERVE for DOUBTFUL DUES		1,500.00
SURPLUS		184,507.79
	$204,950.71	$204,950.71

EXHIBIT B

Statement of Profit and Loss for the Year Ended December 31, 1925

PROCEEDINGS		
Sales	$ 2,075.04	
Dues and Subscriptions	11,772.33	
Advertising	7,641.54	
Total Income from PROCEEDINGS		$21,488.91
Publishing Cost	$17,898.64	
Payments to Authors of Articles	4,743.49	
Prize Essay and Honorable Mention Awards	429.65	
Total Cost of PROCEEDINGS		23,071.78
Loss on PROCEEDINGS (Excludes Overhead)		$ 1,582.87
INSTITUTE PUBLICATIONS		
Sales	$50,761.44	
Inventory—January 1, 1925	$26,174.69	
Purchases from Printers	21,638.44	
	$47,813.13	
Less: Inventory December 31, 1925	19,141.97	
	$28,671.16	
Payments to Authors and Revisors	2,047.77	
Cost of Books Sold	30,718.93	
	$20,042.51	
Less: Contingent Profit	2,670.67	
Gross Profit (Excludes Overhead)		$17,371.84

PURCHASED BOOKS			
Sales		$ 4,656.06	
Inventory—January 1, 1925	$ 157.92		
Purchases from Publishers	5,119.65		
	$ 5,277.57		
Less: Inventory December 31, 1925	1,636.97	3,640.60	
Gross Profit (Excludes Overhead)			1,015.46
Gross Profit on Book Sales (Excludes Overhead)			18,387.30
Loss on PROCEEDINGS (Excludes Overhead)			1,582.87
Gross Profit from Operations (Excludes Overhead)			16,904.43
OVERHEAD OPERATING EXPENSE			
Postage, Express and Hauling		$ 1,124.32	
Office Expense		440.38	
Moody's Investors Service		120.00	
Salaries		11,798.00	
Board Meetings		1,523.52	
Advertising		164.00	
Cost of Collection—Foreign checks		14.40	
Insurance		51.98	
Depreciation (Furniture and Fixtures)		208.74	
Telephone and Telegraph		98.61	
Auditing		225.00	15,768.95
Net Trading Profit			$ 1,035.48
OTHER INCOME			
Income from Interest			8,113.37
Net Profit for year ended December 31, 1925			$ 9,148.85

EXHIBIT C

Comparative Balance Sheet for the Two Years Ended

	DECEMBER 31, 1924	DECEMBER 31, 1925
ASSETS		
CASH in Bank	$ 38,576.76	$ 35,076.46
ACCOUNTS RECEIVABLE	10,704.58	4,270.24
BONDS	116,165.84	141,831.34
INVENTORIES		
Institute Publications	40,621.36	19,141.97
Purchased Books	157.92	1,636.97
Office Supplies	860.70	820.13
FURNITURE and FIXTURES	2,051.93	1,878.69
PREPAYMENTS	612.73	294.91
LIABILITIES		
ACCOUNTS PAYABLE	$ 6,577.24	$ 2,993.63
PREPAYMENTS	6,550.90	7,748.58
DEFERRED CREDITS—"Contingent Profits"	6,728.97	8,200.76

RESERVES				
Doubtful Dues		1,500.00		1,500.00
Inventory		8,000.00		
SURPLUS		180,394.71		184,507.21
	$209,751.82	$209,751.82	$204,950.71	$204,950.71

EXHIBIT D

Comparative Statement of Profit and Loss for the Two Years Ended

	DECEMBER 31, 1924		DECEMBER 31, 1925	
PROCEEDINGS				
Sales		$ 1,997.40		$ 2,075.00
Dues and Subscriptions		14,412.82		11,772.21
Advertisements		3,032.65		7,641.50
Binding		12.00		
Total Income from PROCEEDINGS		$19,454.87		$21,488.91
Publishers Cost	$16,662.03		$17,898.64	
Payments to Authors of Articles	3,663.14		4,743.49	
Prize Essay and Honorable Mention Awards	75.00		429.65	
Cost of PROCEEDINGS	$20,400.17		$23,071.78	
Loss on PROCEEDINGS		945.30		1,582.87
	$20,400.17	$20,400.17	$23,071.78	$23,071.78
INSTITUTE PUBLICATIONS				
Sales		$39,365.68		$50,761.44
Inventory—January 1	$38,994.90		$40,621.36	
Less: Amount charged off—see comments			14,446.67	
	$38,994.90		$26,174.69	
Purchases from Printers	22,413.02		21,638.44	
	$61,407.92		$47,813.13	
Inventory—December 31	40,621.36		19,141.97	
	$20,786.56		$28,671.16	
Royalty to Authors of Books	1,761.47		2,047.77	
Total Cost of Sales	$22,548.03		$30,718.93	
Contingent Profit	6,728.97		2,670.67	
Profit on Sales—excludes overhead	10,088.68		17,371.84	
	$39,365.68	$39,365.68	$50,761.44	$50,761.44
PURCHASED BOOKS				
Sales		$ 5,102.01		$ 4,656.06
Inventory—January 1	$ 611.90		$ 157.92	
Purchases from other Publishers	3,327.43		5,119.65	
	$ 3,939.33		$ 5,277.57	
Inventory—December 31	157.92		1,636.97	
Cost of Sales	$ 3,781.41		$ 3,640.60	
Profit on Sales—excludes overhead	1,320.60		1,015.46	
	$ 5,102.01	$ 5,102.01	$ 4,656.06	$ 4,656.06

PROFIT				
Institute Publications		$10.088.68		$17,371.84
Purchased Books		1,320.60		1,015.46
Interest—Investments and Banks		6,980.67		8,113.37
Bond Transactions		747.50		
LOSS				
PROCEEDINGS	$ 945.30		$ 1,582.87	
OVERHEAD OPERATING EXPENSE				
Postage, Express and Hauling	1,123.47		1,124.32	
Office Expense	832.55		440.38	
Moody's Service	120.00		120.00	
Salaries	10,870.00		11,798.00	
Board Meetings	1,379.60		1,523.52	
Cost Collection	12.31		14.40	
Advertising	150.70		164.00	
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